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Abstracts. Initialled abstracts in the present number are by W. T. Chang (National University of Chekiang, China), W. Gleisberg (Horticultural Institute, Ankara, Turkey), J. L. Edgar, M. H. Moore and H. Wormald.

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Horticultural Abstracts

Vol. V December, 1935 No. 4

HORTICULTURE—MISCELLANEOUS.

518. DORSEY, M. J. 014 : 634/5

Nomenclature—cataloguing of varieties—protection of new discoveries (U.S.A.).

Commun. 11 ème Congr. Int. Hort. (Rome), 1935, pp. 10.

Nomenclature. The code of pomological nomenclature of the American Pomological Society is given and discussed. Two of these rules are of some importance. In naming bud sports of recognized varieties the name selected should as far as possible identify the new strain with the parent variety. In certain cases, where the trade preference for a synonym does not conform to the rules of nomenclature, the trade name may, after consideration, be accepted by the committee on nomenclature. *Cataloguing of varieties.* There is no provision for a national system of registration of fruit names in America. The possibility of the establishment of such a system is briefly examined. *Protection of new discoveries.* Since the passing of the Plant Patent Act 84 patents have been granted, of which 32 were for roses, carnations and peaches coming next with 6 each. Applications would be strengthened by a more extensive use of botanical and genetic knowledge.

519. RAMALEY, F. 016 : 581.14 : 612.014.44

A working bibliography of day-length and artificial illumination as affecting growth of seed plants.

Univ. Colo. Stud., 1933,* **20**, Nos. 2 and 3, pp. 257-63.

The author has collected references on photoperiodism and related topics over a period of seven years. In all 134 references are presented in the hope that they may be of interest to other investigators in this field.

520. CROCKER, W., AND OTHERS. 577.17 : 547.313.2

Similarities in the effects of ethylene and the plant auxins.

Contrib. Boyce Thompson Inst., 1935, **7** : 231-48, bibl. 38.

Among the conclusions reached by the authors are the following :—Ethylene, acetylene, propylene and carbon monoxide are pre-eminently anaesthetics and stimulants for plants and are low in toxicity or tissue-killing power. They produce leaf epinasty. They induce intumescence formation in plants, as does hetero-auxin. Ethylene affects respiration rate. The 4 gases named reduce or stop elongation rate without killing tissues. Ethylene hastens decomposition of chlorophyll and the colouring and other ripening processes of fruits. All four initiate root development, as does hetero-auxin. The minimum effective molecular concentrations of ethylene and of the auxins are approximately the same, both groups of substances being effective at very low concentrations, a common character of hormones and vitamins. There is much evidence that ethylene acts as a fruit-ripening hormone and a possibility that it acts as a growth-rate and organization hormone in vegetative organs of plants.

* Received in 1935.

521. ZIMMERMAN, P. W., AND WILCOXON, F. 581.144.2 : 547.313/314
Several chemical growth substances which cause initiation of roots and other responses in plants.
Contrib. Boyce Thompson Inst., 1935, **7** : 209-29, bibl. 18.

The compounds were used as distilled water solutions or mixed with lanolin. In a few cases where cuttings were involved dilutions were made with Knop's solution. The plants used were African marigold (*Tagetes erecta* L.), tomato, buckwheat, sweet pea, Windsor bean (*Vicia Faba* L.), sunflower, Jerusalem artichoke, dahlia, sensitive plant (*Mimosa pudica* L.), and *Chenopodium album* L. Previous work had shown that root initiation could be induced by carbon monoxide, ethylene, propylene, acetylene, indolepropionic acid, phenylacrylic acid, phenylpropionic acid and indoleacetic acid. The present experiments were made with α-naphthaleneacetic acid, β-naphthaleneacetic acid, acenaphtheneacetic acid, indolebutyric acid, phenylacetic acid, fluorenacetic acid, anthraceneacetic acid and α-naphthylacetonitrile. The chief responses made were local initiation of adventitious roots on stems and leaves, proliferation, swelling and bending of stems, acceleration of growth and epinasty of leaves. Of these substances it is found that α-naphthaleneacetic acid and indolebutyric acid are the most effective root-forming substances known as yet. The particular effects on the different plants of the various substances were noted and are described here.

522. MURNEEK, A. E. 581.175.11 : 581.162
Relation of carotinoid pigments to sexual reproduction in plants.
Science, 1934, **79** : 528, bibl. in text.

Soybeans, *Soja max*, exposed to a short day of 7 or 8 hours compared with a long day of 14 to 15 hours, at first exhibit much lighter foliage colour, but soon take on a similar shade, and finally during the reproductive period become intensely green. A large number of determinations have shown that in the leaves of both long and short-day plants approximately similar concentrations of chlorophyll are present, but, as the short-day plants enter the reproductive state, they show an increased carotin and xanthophyll content. This concentration appears to reach a maximum at the time of flowering and then to decrease. Similar tests with cosmos, *Cosmos bipinnatus*, and salvia, *Salvia splendens*, show the same trend. The exact meaning of this phenomenon is not known, but an analogy is found in animals, in which the carotinoids are present in quantity in various organs and secretions associated directly or indirectly with reproduction.

523. STRICKLAND, A. G. 634/5 : 581.084 : 519
Error in horticultural experiments.
J. Dep. Agric. Vict., 1935, **33** : 408-16, bibl. 6.

Part I. *Yield variability of several horticultural crops in relation to the planning of field experiments.* The results of uniformity trials on grape vines, apples, peaches and tomatoes are examined and discussed. The method of the analysis of variance is used to eliminate non-random types of variation, leaving the true random variation expressed in terms of the coefficient of variability (C.V.). This is used to determine optimum size of plot and the number of replications necessary to demonstrate specific differences between treatments. With vines adjacent unit plots of a single vine were, unlike small unit wheat plots, poorly correlated, and increase of the size of plot resulted in a relatively larger decrease in the C.V. than was obtained by increasing the size of the wheat plots. Diagrams to illustrate this are given. The results of a previous vine uniformity trial are quoted. The C.V. of a unit plot of 1 vine was 33·4% for yield. Plots of 10 vines showed a C.V. of the order of 10%, and this size of plot was considered convenient for field experiments. In this trial differences of 10% between treatments could be proved with 9 replications, and of 20% with 4 replications. The C.V. of the yields of unit plots of one tree in a peach uniformity trial was found to be 26·9%. By means of grouping the yields of different numbers of trees in square and long plots the C.V's of plots of various sizes were calculated, and these are tabulated and graphically represented. There is a close agreement between the actual and theoretical curve for random variation. The apple uniformity trial described was

carried out on an even block of Jonathan apples. The C.V. for one year's yield of a unit plot of one tree worked out at 18%. The C.Vs. for various sizes of plots are tabulated as before with apples. Single tree plots may be used, but this is impracticable with vines and peaches, owing to the large number of replications required. In practice plots of 4-8 trees or vines are convenient field units. In a tomato uniformity trial the area was divided into small plots of 6 plants which were harvested separately. The C.V. = 17·2% for a 6 plant plot. The curve for actual variation in this case is considerably higher than for the theoretical curve. Progressive expansion of the plot size from 6-36 plants gives a regular reduction in C.V. from 17·2% to 9·2%, but with larger plots the C.V. does not fall much below 9%. The optimum reduction in error is given by plots in the region of 36 plants. Part II. *The variable cool storage behaviour of Jonathan apples, and the bearing thereof on the technique of cool storage trials.* Apples harvested from different trees do not behave similarly during cool storage, and this is a frequent source of error in cool storage experiments. A storage uniformity trial on a number of cases of Jonathan apples is described. The major cause of wastage is due to breakdown. A frequency curve for 5% total wastage is given. The mean period occupied in reaching 5% breakdown was 35·1 weeks, and in reaching 5% total waste was 31·4 weeks. The C.V. proved to be 27·4% in each case. The results of this cool storage trial are used as a basis for suggestions regarding the application of statistical methods to cool storage. J.L.E.

524. ROGERS, W. S., AND VYVYAN, M. C. 634.1/2 : 581.084 : 681
A device for serial recording* and automatic counting in categories.
J. Pomol., 1935, **13** : 220-2, bibl. 1.

The " categorimeter ", so called, consists of a portable typewriter with reset counters attached to certain keys. The method on which it works is here described. It can be used indoors or in the field where it conveniently stands on a small table or apple box. It greatly facilitates the taking of a quick summary of plant growth. Actually it records observations represented by various letters in serial order [see abstract 550.—ED.] and automatically counts the number of cases in different categories. In the case of growth census records or plant to plant surveys of plots a series of records of the same plants can be made on one sheet showing the progress of each plant.

525. HOPKINS, J. W., AND JAMES, M. F. 581.113 : 551.56
Temperature, wind, humidity and evaporation in agricultural meteorology.
Canad. J. Res., 1935, **13** : 191-201, bibl. 7.

From statistical studies of evaporation and allied meteorological observations for a period of 20 years at stations in Montana and New Mexico it is shown that evaporation was markedly influenced by wind and vapour pressure as well as by temperature. It is concluded that evaporation measurements should, therefore, supplement temperature records in agricultural meteorological studies.

526. PEECH, M., AND BATJER, L. P. 631.4 : 634.1/8
A critical study of the methods for measuring oxidation-reduction potentials of soils, with special reference to orchard soils.
Bull. Cornell agric. Exp. Sta., **625**, 1935, pp. 23, bibl. 14.

By a study of soil oxidation-reduction potentials in early spring, Bradfield and others (*Bull. Cornell agric. Exp. Sta.*, 592, 1934, *H.A.*, 1934, 4 : 4 : 508) found it possible to eliminate 80% to 90% of poor orchard sites. In the article describing this study their technique was described. Further technical details and modifications are given here. The present authors summarize as follows :—A method of measuring the oxidation-reduction potentials of soils suspended in N/10 H_2SO_4 using a vacuum-tube potentiometer is described in this bulletin. The method of suspending the soils in N/10 H_2SO_4 for redox measurements was found to have the following advantages over the soil-water-suspension method :—(1) The microbiological activity is stopped in this concentration of acid, and hence no reductions of the soil can take place between the time

* For other recording apparatus see *Annu. Rep. East Malling Res. Sta. for 1928-1930, II. Supplement*, 1931, A.14, pp. 65, *H.A.*, 1931, 1 : 2 : 115.

of sampling and the time when the measurements are made. (2) Although many soils showed an apparent oxidation on standing regardless of the pH value of the suspension medium, a number of those investigated were found to be less susceptible to oxidation in the acid suspension. (3) The time necessary to reach a stable, and therefore reproducible electrode potential in acid suspensions is much shorter than in soil water suspensions. (4) The final value of E_H obtained in acid suspensions is not affected by the previous reading of the electrode, and consequently the oxidation-reduction potentials are much more reproducible. In an experiment carried out to determine the proper time of sampling the soil in the spring, it was found that no appreciable reduction of the soil will take place until the temperature of the soil has increased to approximately 55° F. [Authors' summary.]

527. SMITH, L. J., AND GARVER, H. L. 631.67
Farm irrigation pumping systems.*
Bull. Wash. agric. Exp. Sta., **311**, 1935, pp. 24, bibl. 14.

Three types of pumps are mentioned, the rotary and gear types, reciprocating pumps, and centrifugal pumps. Of these the last are undoubtedly the best suited for irrigation purposes of all sorts, except where the water output is very small, 20 gallons per minute or less. The design, installation, and care of this type is described in more detail. The following distribution systems also receive a mention:—furrow irrigation, flooding, including the use of porous canvas hoses, and sprinkling. Pipes for the conveyance of irrigation water may be iron, wood, tile, or concrete. The first two are by far the most popular, and tables are given showing friction losses in relation to pipes of different diameters and at various rates of discharge of water. Flumes are made of wood or galvanized iron, and figures are given for the flow of water in rectangular wooden flumes of several widths at different gradients. Finally a table is provided showing the number of hours and minutes to the nearest five minutes required to cover an acre to depths of 1 to 6 inches at various rates of flow.

TREE FRUITS, DECIDUOUS.

General.

528. BEVERLEY, G. W. 634.63
Why not plant olives ?
Agric. Gaz. N.S.W., 1935, **46** : 451-4.

The planting of olives in New South Wales is advocated on the ground that they are profitable, useful as windbreaks and shade, and ornamental. The former objection that olives harboured brown olive scale has been removed by the fact that complete control can now be obtained by the parasite *Muscidea cyanea*, which also acts as a control of scale on citrus trees. The most suitable varieties for dry districts are Verdale and Hardy's Mammoth, while Mission, Pleurer, Correggiolo and Herbequina are others of outstanding merit. Cultural directions are given.

529. ANON. 634.11
Investigations in connexion with the apple industry (in Australia).
J. Coun. sci. industr. Res. Aust., 1935, **8** : 237-9.

The Council for Scientific and Industrial Research is carrying out investigations on the following subjects. (1) The various disorders affecting different varieties of apple in storage. (2) Biennial bearing in apple with special reference to the process of fruit bud formation and the relation of this process to the growth of the tree in varieties of both annual and biennial habit. Results so far indicate the necessity for investigating, firstly the possibility of developing a commercial method for reducing the heavy blossom in the on year to an amount sufficient only to set a moderate crop and secondly the possibility of finding sufficiently good varieties possessing the annual habit to replace the biennial bearers now used. (3) Rootstock trials in Queensland. (4) Wastage in stored Jonathans and its control. (5) Standardization of a suitable apple case.

* For other articles dealing with irrigation see 555-9.

530. Hampson, C. C., and Landerholm, E. F. 634.13
Cost of producing pears in Washington.
Bull. Wash. agric. Exp. Sta., **307**, 1935, pp. 24.

Production costs are given for 46 orchards in the Yakima and Wenatchee districts of Washington for the 1932 crop. Wide differences were shown between the two areas, and between individual orchards in each area. Average acre yields in the Yakima district were 7·8 tons cannery pears and 268 packed boxes, and in the Wenatchee district 16·3 tons cannery pears and 421 packed boxes. Per acre costs were higher in the latter, but costs per ton or per box were lower. Average acre costs covering both areas were $187·96 for all pears, $183·43 for cannery pears, and $310·80 for packed pears. This gave an average cost for all kinds of pears of $20·72 per ton, packed pears costing 87 cents per box, and cannery pears $18·77 per ton.

531. Faes, H., and Aubert, Ph. 634.22
Enquête fruitière en Suisse romande. L'étude des prunes (1931-1933).
(**Fruit survey in French Switzerland. Study of plums.**)*
Tirage à part de l'annuaire agricole de la Suisse, 1934, pp. 795-841.

Answers to a comprehensive questionnaire have shown that the number of local varieties planted surpasses that of well-known varieties, but that among these local varieties there do not appear to be any of surpassing merit. Most of them have obvious defects and, although an exact description of each is filed at Lausanne, they are not described in this article. Here notes are made on the botanical classification of plums and on the classes *P. domestica*, *P. insititia*, *P. spinosa*, and *P. cerasifera*. The plums grown in French Switzerland are divided arbitrarily into 5 groups according to the outward appearance of their fruits or similar utilization, and those of particular merit in Swiss orchards are described with notes from the different cantons on their behaviour there. These groups are the Quetsche or wild plum group† including 4 varieties, the Gage with 5 varieties, the Mirabelle 2 varieties, a further group including some 8 varieties well-known outside Switzerland, and a fifth group in which 5 local varieties showing certain good traits are described. For Swiss conditions the following planting recommendations are made :—From 600-700 m. (1,900-2,275 ft.) Jaune de Catalogne [Jaune hâtive‡], Reine Claude Violette, Reine Claude Verte, Pruneau Gygax, Quetsche d'Italie. From 800-900 m. Bleu de Belgique [Belgian purple], Prune Pêche, Petite Mirabelle, Grosse Mirabelle, Kirke's, Hâtif de Bühl, Quetsche d'Allemagne [German Prune]. From 1,000-1,200 m. Bérouge, Reine Claude d'Oullins [Oullin's Gage], Pruneau de Chésard. The advice is given that local varieties should gradually be topworked to better varieties and that anyone planting up an orchard on a large scale should seriously consider the claims of Mirabelle as a preserving plum and the Quetsche prune which offers success in the dried plum trade. With this article the authors conclude their surveys on Swiss fruit varieties. Previous surveys have dealt with cider fruits, dessert apples, dessert pears, and cherries.

532. Yeager, A. F., and others. 634.1/8
The native fruits of North Dakota and their use.
Bull. N. Dak. agric. Exp. Sta., **281**, 1935, pp. 26, bibl. 8.

The more useful " wild " fruiting species found in North Dakota belong mainly to the following genera :—*Amelanchier*, *Crataegus*, *Fragaria*, *Rubus*, *Prunus*, *Shepherdia*, *Ribes*, *Viburnum*, and *Vitis*. Descriptions are given of one or more species belonging to each genus, and in some cases there are individual as well as general directions for making fruit preserves, jams, and jellies. The authors urge that owing to the scarcity of local cultivated fruit, these native types should be utilized to the fullest extent when found. Many, too, do well under cultivation, and some are of additional use as low growing shrubs in shelter belts.

* For cherries see *Ibid. for 1932*, pp. 367-425, *H.A.*, 1933, 3 : 2 : 146.

† Bunyard in his Handbook of fruits, stone and bush fruits refers to common Zwetsche or Quetsche domestique as synonyms for German prune.

‡ Names in brackets are synonyms given in Bunyard's book.

533. YEAGER, A. F. 634.1/8
Growing fruit in North Dakota.
Bull. N. Dak. agric. Exp. Sta., **280**, 1935, pp. 48.
Fruit growing in North Dakota has not assumed any commercial importance, and in the author's opinion is unlikely to expand beyond local market requirements. The present paper is therefore designed to assist persons wishing to plant small subsidiary fruit gardens. In the region under consideration rainfall ranges from 18 to 24 inches in the east to 12 to 16 inches in the west; winters are cold and the average frost free season varies from only 100 to 130 days. The bulk of the paper is concerned with the planting, cultivation, and harvesting of the more suitable fruit types.

534. BEATTIE, W. R., AND OTHERS. 634/5
Subsistence farm gardens.
Fmrs.' Bull. U.S. Dep. Agric., **1746**, 1935, pp. 54, bibl. 9.
The object of this paper is to supply a guide to families undertaking subsistence farming as a means of supplementing their food supplies and occupying their spare time by growing vegetables and fruits. The information applies primarily to conditions found in the Northern and Eastern States.

535. BOSCHINI, G. 634.1/2-1.543
Impianti autunnali e impianti primaverili. (**Autumn versus spring planting.**)
Reprint from *Romagna agricola e zootecnica*, 1934, Nos. 11-12, pp. 12.
The records are here given of one year's observations on the differences in growth of young peach trees, 90 being planted out in the second half of November and 92 early the following April. The growth made in one year from planting definitely favours autumn planting and it is suggested that results would have been even more in its favour, had the winter climatic conditions been better and the spring drier. The trees are to be kept under observation.

*Propagation.**

536. RIEBESEL, G. 634.1/7-1.541.11
Vegetative Vermehrung von Obstgehölzen. (**Vegetative reproduction of fruit trees.**†)
Züchter, 1935, **7**: 156-9.
The irregular growth of fruit trees in the region of Halle caused search to be made for strong growing rootstocks. It was found that layering desirable stocks to obtain clones was wearisome and not always entirely successful. Softwood cuttings were quite unsuccessful. Finally the writer tried grafting on root pieces and achieved considerable success by this method. As a result he applied for and took out Patent No. 582983 of April 27th, 1932. In an extract from this patent which is entitled " Verfahren zur Aufzucht von Obstgehölzen " (a method of raising fruit trees), an outline of piece root grafting is given. The author claims that the method allows of the easy production of large quantities of clonal material and may be applied to most of our deciduous tree fruit species. He is at present experimenting with root pieces of the following material:—*P. Mahaleb* clones, pear seedlings, doucin and other apple clones, and he gives a short illustrated account of the varying success achieved to date. He states that the method can only be carried out with his permission and after agreement with him. [As, however, the method of bench grafting has been known for a very long time in England and is a common enough practice in parts of the U.S. as also with Northern Spy in Australia, it seems doubtful whether he will receive many applications from those quarters.—ED.]

* See also 521. † Full translation available.

537. CHANG, W. T. 634.13-1.541.11 : 551.56
Climatic influences on the affinity of pear grafts in Hangchow. [In Chinese.]
Res. Pap. Nat. Univ. Chekiang, June, 1933, pp. 16, bibl. 4.
The objects of the experiment were to discover :—(1) the optimum time and weather conditions for grafting pears in Hangchow, and (2) the stocks which gave the best results as regards "take" (without regard to subsequent compatibility). 1. Bartlett and Kieffer were worked on 1,740 *Pyrus Calleryana* seedlings between February 17th and April 7th, 1933, at the rate of 20 plants daily for each variety. The following results were recorded. Bartlett had a comparatively lower percentage "take" than Kieffer, probably because of the partial incompatibility of Bartlett on *P. Calleryana*. The middle of March proved to be the best time for Kieffer and the end of March for Bartlett. On dry days or days without rainfall the percentage of success was considerably lower than on days of relatively high humidity or days on which rain fell, particularly just before or after grafting. 2. Kieffer and Bartlett were grafted on the following seedling varieties in numbers varying from 28-200 :—*P. Calleryana, P. Malus floribunda, P. baccata, P. baccata manshurica, P. triflora, P. betulaefolia, Chaenomeles chinensis* (syn. *Cydonia sinensis*) and *Chaenomeles lagenaria* (syn. *Cydonia japonica*). These grafts were made from March 17th to 19th and were examined—Kieffer on April 26th and Bartlett on May 16th. Kieffer gave a higher percentage "take" throughout the whole series and showed a greater affinity for *Chaenomeles* than Bartlett. The percentage "take" of Bartlett was influenced greatly by the stock variety but was always lower than that of Kieffer. The botanical relationship between stock and scion appears to play some part in these results. Kieffer, which is a hybrid between *P. serotina* and *P. communis* did well on *P. Calleryana* and *P. betulaefolia*, while Bartlett on the same varieties was very unsuccessful. W.T.C.

*Rootstocks.**

538. UPSHALL, W. H., AND RUHNKE, G. N. 634.1/2-1.541.11-1.453
Growth of fruit tree stocks as influenced by a previous crop of peach trees.
Sci. Agric., 1935, **16** : 16-20.
In 1931 with Mazzard and again in 1933 on an adjoining area with Mahaleb, Myrobolan and French pear seedling stocks growth was greatly restricted in places where peach trees had been growing from 1921-7, although the ground had been cropped and cultivated subsequently. Chemical examination of the soil failed to show sufficient differences in soil texture or fertility completely to explain the differences in growth between plants occupying the tree sites and those in the intervening areas, although water soluble phosphorus and water soluble potassium was higher in the surface soil (but not in the subsoil) of the latter. Photographs illustrate the very marked retardation of growth. The observations were made at the Ontario Horticultural Experiment Station, Vineland.

Rootgrowth.

539. ROGERS, W. S. 634.11 : 581.144.2 : 631.432
Root studies VI. Apple roots under irrigated conditions, with notes on use of a soil moisture meter.
J. Pomol., 1935, **13** : 190-201, bibl. 7.
The excavation was made of the complete root system of an 8-year-old McIntosh apple tree on seedling rootstock growing in an irrigated orchard of sandy soil at Summerland, B.C., and details are here given of the branch and root measurements. In addition some 175 3-year-old apple trees of different varieties all on Canada Baldwin seedling piece roots were excavated and examined in less detail prior to replanting. Incidentally out of 14 varieties excavated 9 showed definite scion rooting, and it was found in all the 17 Rome Beauty, 12 McIntosh Red, and

* See also 537, 590.

8 Hyslop Crab trees examined. These were compared with comparable trees on Malling clonal stocks also excavated at Summerland. Great variation was found between the seedling root systems even when grafted with the same variety. In general it was found that the clonal rootstocks had numerous small roots, as is the case at Malling in England, while the seedling stocks of the same age had fewer roots with a much more marked downward tendency. Actually the clonal stocks had, unlike the seedling stocks, been transplanted after their first year, but the author does not consider it likely that this fact would account for the great contrast. Under these irrigated conditions both roots and branches showed great vigour. Two years after planting roots had reached a length of 5 ft. and a depth of 3 ft. 6 in. Excavation of a 12-year-old Winesap suffering from " collar rot " showed that most of the main roots were dead at the crown. Some were dead throughout and some were alive below the crown. Finally, an account is given of the working and use of a continuous-reading soil moisture meter in the field, and the capillary pull corresponding to optimum growth conditions is discussed.

540. Rogers, W. S. 631.4 : 581.144.2 : 634.11

Soil factors in relation to rootgrowth.

Trans. 3rd Int. Congr. Soil Sci., 1935, **1** : 249-53, bibl. 7.

Comparison is made between the root systems of Lane's Prince Albert apple on known clonal rootstock from comparable experimental plots on (1) deep sandy soil containing in the subsoil 98% coarse and fine sand, 2% silt and clay, (2) clay containing 8% coarse and fine sand and 82% silt and clay, (3) loam containing 55% coarse and fine sand and 21% fine silt and clay. Roots in the sand were long, thin and straight, their spread being 2 or 3 times that of the branch spread. From a shallow scaffolding of main roots vertical roots descended to various depths up to 190 cm. on the most vigorous stocks. The trees themselves were relatively small. In clay root spread was 1·6 times the branch spread, the roots being shorter, stouter, tapering, rapidly branching and twisting. Main roots descended obliquely for 30 to 60 cm. then grew horizontally. Branch roots grew upwards and downwards with a marked depth boundary at 90 cm. The trees were of relatively medium size. In loam root spread was 1·6 times the branch spread, the form of the root being intermediate between those in sandy clay. Numerous vertical roots descended from a shallow scaffolding to the ragstone rock lying 100-300 cm. below, then turned and ramified profusely. The deepest root, which belonged to a very dwarf tree, reached 296 cm. The trees were relatively large. In all soils the feeding roots were fairly evenly distributed over the whole system and reached well beyond the branch spread. The stem:root ratio was 0·9 on sand, 2·1 on clay and 2·2 on loam. Thus more than twice as much root was required to support a given amount of top on sand than on loam. Rootgrowth increased and diminished with the rise and fall of the thermometer but with sufficient soil moisture as a limiting factor. Tests with a soil moisture recorder showed that irrigated orchard soils full of roots dried almost equally at 1 ft. and 3 ft. A rainfall of ·27 inches reached 1 ft. but not 3 ft. Furrow irrigations of 3 inches reached 3 ft., with percolations from the saturated areas to the drier parts lasting 2 or 3 days.

Pollination.

541. Elssmann, E. 634.11 : 581.162.3

Die Befruchtungsverhältnisse bei unseren Obstsorten. III. Äpfel (Sammelreferat). (**Pollination of fruit trees. III. Summary of the position with regard to apples.**)

Züchter, 1935, **7** : 84-95, bibl. 65.

The author sets out in concise form the more important results of apple pollination work achieved in Europe and America up to the present and discusses how these results affect modern practice. Although parthenocarpy is not rare in the apple and parthenogenesis has been noted on more than one occasion, neither is of any practical importance to the grower. The germination percentage of pollen has in the past rightly been considered as one important sign of the suitability of using

any particular variety as pollinator, but recent work in America indicates that from a practical standpoint varieties showing a 30-60% pollen germination are just as useful pollinators as those showing a 80-100% germination. The basic cause of the production of efficient pollen grains would appear to lie in chromosome composition, and in general triploid varieties (2n = 51) are very poor pollinators. There are indications, moreover, that the development of the embryo sac mother cells and of the rest of the female reproductive apparatus is liable to be more irregular in triploid varieties than in diploid, but further work is necessary here. Absolute inter-sterility, not to be confused with commercial inter-sterility, would appear to be extremely rare in apples and to be confined to closely related varieties, e.g. bud mutations of Delicious. The only proved instance of inter-sterility in the field in Germany is that of Ribston Pippin (triploid) ♀ × Cox's Pomona ♂. In practice orchards should contain at least 2 varieties, or 3 if one of them is a triploid. Finally, lists are given of good (31-100% germination) and bad (0-30%) pollinators drawn up by reference to the observations of the leading European authorities. In this list varieties are marked as being inclined to parthenocarpy, as being diploids or as being triploids, when at least two of the authorities cited have by cytological investigation found them to be so.

542. Krümmel, H. 634.23 : 581.162.3
Die Befruchtungsverhältnisse bei unseren Obstsorten. IV. Kirschen (Sammelreferat). (**Pollination of fruits. IV. A summary of the position with regard to cherries.**)
Züchter, 1935, **7** : 264-72, bibl. 48.

A. *Sweet Cherries*. German and other investigators have shown that the sweet cherries are for practical purposes not self-fertile, and that there is, moreover, a considerable amount of cross-infertility between varieties. Hive bees are of the greatest importance for their pollination owing to the comparative earliness of flowering. Pollen may also to a limited extent be successfully carried by wind, but the wind must be strong and the distance traversed small. The task of research workers is to test the inter-fertility of different varieties where this has not already been done, and the following rules should be observed by growers. No solid plantings of sweet cherries should be made. There should be one pollination tree for every six of the main variety. Times of flowering of the two varieties concerned must overlap. Hive bees should be kept if possible. Only such varieties should be planted for pollinating purposes as have experimentally or in practice been found suitable. A table is given showing very exactly the results of pollination experiments by the author and Kamlah in Central Germany between the years of 1926-30 and 1932-35, by Branscheidt in the Palatinate in 1930-31, and by Schanderl near Trier in 1931. B. *Sour Cherries*. No cases have as yet been proved of cross-infertility in sour cherries. On the other hand sour cherries have frequently been found to be uncertain pollinators of sweet cherries, although effectively pollinated themselves by the sweet cherries. Both self-fertile and self-infertile varieties are found, insects, especially bees, being necessary for pollination in both cases. The following are noted as being definitely self-fertile :—Shade Morello, Diemitzer Amarelle, Gros Gobet, Belle de Choisy, Bettenburger Glaskirsche. Good pollinators are suggested for the following, which under central German conditions, appear generally to need cross pollination :—Griotte d'Ostheim, Koch's Verbesserte Ostheimer, Süsse Frühweichsel, Early May, Spanische Glaskirsche, Belle de Chatenay, Rote Mai, Impératrice Eugénie, Reine Hortense. Pure stands should only be planted, where the variety is known to be self-fertile. Where there is doubt, the same precautions should be taken as in the case of sweet cherries above.

543. Hu, C. C. 634.13 : 581.162.3 +631.522
Sterility in pears. [In Chinese.]
J. agric. Ass. China, 1933, No. 140-1 : 77-90.

It has long been known that there is a strong tendency to sterility in pears. H. C. Chang working in Shantung (1931) on " Tze Li " pear (variety of *Pyrus Bretschneideri* Rehder) found no set at all on " selfed " flowers ; whereas the percentage blossom set on flowers crossed with

" Duck " pear, " Da Ching " and " Ching Tza " (all of the *P. Bretschneideri* group) had averaged above 90%. Among *Pyrus serotina* Rehder pears Young Tsing and Chuchi in Japan have proved self-sterility, while R. G. Swayne (1821), Waite (1895), and Tuft and Philp (1925) have found a high percentage of sterility in *Pyrus communis* L. The author had experimented with the following varieties beginning in 1934 in Nanking. Garber, Le Conte (hybrid between *P. communis* and *P. serotina*) Twentieth-Century (*P. serotina*), Bartlett, Winter Nelis (*P. communis*). A close examination of the date of blossoming for each variety of pears is made. The order of blossoming ranges as follows :—1. Garber and Le Conte, 2. *Pyrus communis*, 3. *Pyrus serotina*. Methods of emasculation, bagging and pollination are described in detail. The result of pollination and percentage blossom set is tabulated. Cross-fertilized flowers showed a much higher set, averaging 40%-85%, than selfed flowers. To discover the reasons of sterility, the author has examined the structure of the floral organs, and made artificial cultures to test pollen germination. It is found that the Garber pear has longer stamens than pistils, averaging about 9·0 mm. and 5·8 mm. respectively. In the flowers of Le Conte, Bartlett and Winter Nelis, the pistils are all shorter than the stamens. In Vantihani's culture method at a temperature of 18° C. with 5/10 m. saccharose solution + 2% agar medium, all pollen tested from the above mentioned pear varieties germinated above 90%. Whether sterility in pears is due to the rate of pollen tube growth or to any factorial incompatibility will, it is hoped, have been decided before the next report is issued. The selection of the best pollinators for each variety is under experiment. W.T.C.

544. HOOPER, C. H. 634.13 : 581.162.3

Pears—their pollination, the relative order of flowering of varieties, their cross fertilization and the insect visitors to the blossoms.

J.S.E. agric. Coll. Wye, 1935, No. **36**, pp. 111-8, bibl. 11.

The author briefly recounts the results of his self-fertility tests with some 78 varieties of pear, 38 of which matured fruit to some extent with their own pollen. He tabulates the comparative results of leaving bagged, bagging and pollinating with their own pollen, bagging and pollinating with foreign pollen 9 well-known varieties of pear, and shows that whereas when self-pollinated or left the ratio of flowers to matured fruit was about 100 : 6, hand pollination with foreign pollen resulted in a ratio of 100 : 22. In a further table he gives the approximate order of flowering in several English counties of 46 pear varieties and notes from Rawes' work their relative self-fertility. A diagram of the order of flowering of 48 varieties based on records at Wye and elsewhere follows. Finally, a list is given of varieties found in practice to be effective pollenizers for particular varieties by Rawes, Crane, Lawrence and Hooper.

545. DOTTI, F. 634.22 : 581.162.3

Il problema della fecondazione in frutticoltura. (**Fruit fertilization problems.**)

Reprint from *Riv. apicoltura*, 1934, fasc. 2, pp. 16, bibl. 30.

The author recounts the results of his pollination experiments with Burbank and Santa Rosa plums using growing trees with a muslin cage with and without the inclusion of flowering branches of the other variety and with and without bees. He confirms the conclusions reached by Morettini (*Ital. agric.*, 1932, 69 : 961, *H.A.*, 1933, 3 : 1 : 24) and by American workers that Burbank is self-sterile and that Santa Rosa is a good pollinator of it, but disagrees with Morettini, though not with American workers, in that he finds Burbank not to be an effective pollinator for Santa Rosa. He notes that American workers have found Abundance, Beauty, Formosa, and Wickson and that Morettini in Italy has found Shiro and Myrobolan good pollinators for this variety, which is, like Burbank, for practical purposes self-sterile. Where bees were excluded from his cages, negligible, if any, pollination took place and he therefore stresses the importance of bees in the orchard. In view of the danger of poison sprays he makes the following suggestions :—1. The permanent position of hives should be a long way off the orchard. 2. No poison spraying should be done during flowering. 3. The bee hives should be introduced into and kept in the orchard merely during the time of flowering.

Growth, Nutrition.

546. Ragland, C. H. 634.22+581.145.1/2
Fruit-bud differentiation in the sugar prune.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, **32** : 50-1, bibl. 2.
Bud samples from non-fruiting sugar prune trees were collected at Davis, California, at fortnightly intervals from May 9th, 1934, onwards. By June 4th the growing points appeared slightly broadened, and a week later there could be no doubt but that differentiation had begun. The 1934 season was rather earlier than normal, and it is suggested that in most seasons differentiation may occur a week or two later. The author suggests, however, that any treatment devised to encourage an annual bearing habit is unlikely to be effective if applied after June 1st.

547. Hendrickson, A. H., and Veihmeyer, F. J. 634.25-1.432
Size of peaches as affected by soil moisture.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, **32** : 284-6, bibl. 1.
The experiment described here was conducted in a Phillips peach orchard at Davis, California. The soil was a loam, the field capacity for the top 3 feet was about 22%, and the permanent wilting percentage 11 for the top 3 feet and 9 for the second 3 feet. Four irrigation treatments, A, B, C and D, were started in 1931. In A water was applied, whenever the supply in the top 3 feet of soil fell to about 13% or 14%, that is within 2 or 3 of the permanent wilting percentage. In B water was not applied until the supply in the first 6 feet had been reduced to about the wilting percentage. In C irrigation water was applied as for A up to July 1st, after which no further water was given. In D the trees were left unirrigated. As regards yield over the 4 years 1931 to 1934 there was no difference between A and B, C was somewhat lower, but not always significantly so, and D gave definitely smaller yields. Size, as reckoned on the minimum of $2\frac{3}{8}''$ diameter allowed by canneries, showed more striking differences. In both 1933 and 1934 A gave over 70% marketable fruit, B averaged about 50%, C gave 14·6% the first year and 41·7% the second, whilst D produced virtually no marketable fruit at all.

548. Chang, W. T. 634.1-2.432
Relation of soil moisture conditions to the growth of some *Prunus* species.
[In Chinese.]
Res. Pap. Nat. Univ. Chekiang, June, 1934, pp. 18, bibl. 2.
The following material was used in this experiment :—(1) *Prunus persica* Stokes seedling and *P. Davidiana* seedling and the following grafted on *P. persica* seedling—Senchow, Shanghai, Honey, Pien-to, etc. (2) *P. Mume* Schneid seedling and the following grafted on it—Hankow Green, Tongsi Yellow, etc. (3) *P. triflora* L. seedling and the following grafted on it—Chinese Red Plum, Chinese Yellow Plum, Kashing Sweet, etc. (4) *P. Pseudo-cerasus* L. seedling and the following grafted on it—Chinese Cherry. (5) *P. armeniaca* L. seedling and the Red Chinese Apricot and Yellow Chinese Apricot grafted on it. (6) *P. tomentosa* seedling. (7) *P. communis* seedling. (8) *P. triloba* seedling. (9) *P. Mahaleb* seedling. All plants were about uniform size, being selected from two-year maidens, and measured about 3 ft. in height. All plants were set similarly on January 28th, 1933, in specially made earthen pots 25 inches diameter and 40 inches in height. The outsides of these pots were enamelled and waterproofed. The soil used for planting was air-dried silt-loam. The moisture equivalent of this soil is 17·10%, hygroscopic coefficient 6·33, wilting coefficient 9·30. The soil in each pot was carefully weighed and made to equal 38 lb. Each variety of plants was divided into 3 sets with 3 plants each in the same pot. Water was applied after planting and subsequently every three weeks. The first set of plants was supplied with 500 c.c. each application, second set 1,000 c.c. and third set 2,000 c.c. The pots after planting and after each application of water were re-waterproofed with wax paper. The

following results were noted :—(1) Seedling plants had an earlier bud-break when compared with the grafted plants of their respective relatives. (2) 500 c.c. H_2O per pot was about optimum for seedling plants, 1,000 c.c. was excessive for seedling plants and about optimum for most grafted varieties, 2,000 c.c. was excessive for both seedling and grafted plants. (3) *P. persica*, *P. triflora*, and *P. Pseudo-cerasus* required more water to induce early bud-break, whereas *P. tomentosa*, *P. triloba* and *P. Davidiana* required very much less. *P. communis* and *P. Mahaleb* seemed to require more water for their further growth. (4) *Prunus Mume* showed the most resistance to waterlogging in the 2,000 c.c. set, whereas *P. persica* seemed to be extremely susceptible to damage from this source. On the other hand, *P. persica* showed the best drought resistance in the 500 c.c. set, whereas *P. Pseudo-cerasus* suffered severely from dry soil conditions. (5) It seemed obvious in this test that the plants in waterlogged pots passed into a more or less yellow chlorotic condition and showed greater susceptibility to brown-rot disease, especially *P. persica* varieties. W.T.C. [Author.]

549. Askew, H. O. 634.11 : 581.192

Changes in the chemical composition of developing apples.

J. Pomol., 1935, **13** : 232-46, bibl. 2.

The author describes the results of 15 weekly analyses, starting about 35 days after maximum bloom, of Jonathan and Dunn's Favourite apples from trees growing on the Moutere Hills soil type in Nelson Province, N. Zealand. In these soils marked lime and phosphate deficiencies are found. On the areas on which the present trials were based fertilizers containing N, P_2O_5 and K_2O were used. All the fruits grew satisfactorily. There was indication that heavy rain was followed by increased growth rate and moisture content of the fruits. In the first samples taken on November 12th with the fruit about 35 days old starch was just appearing. Starch formation is found to begin in the layers of tissue near the periphery and to progress thence to the core area. With ripening fruit the core areas are the first to become free from starch and the peripheral areas the last. The nitrogen and ash percentage decreased steadily, the rate varying with the initial concentration of the constituent concerned and the time elapsing from the taking of the first sample. The initial concentrations and rates of fall varied with the variety of apple and growth conditions in the orchards. The rate of accretion of dry matter and of intake of nitrogen and ash decreased after about 95 days from maximum blossom date. After about 120 days the uptake of nitrogen and ash apparently ceased.

550. Vyvyan, M. C. 634.11 : 581.144.4

Leaf relations of fruit trees. II.* The census method for recording summer growth, with special reference to the apple.

J. Pomol., 1935, **13** : 202-19, bibl. 25.

1. An easy method for rapid recording of summer growth is described.† 2. Growths are classified into categories on the basis of easily recognized characters such as order (primary or secondary), performance (bearing or non-bearing), activity (growing or non-growing) and size (short or long). 3. Each category is given a letter of the alphabet as a distinctive symbol. 4. Each growth in turn from the apex to the base of the tree or sample branch is examined and its category recorded ; the result is a census of growths of each category and a map of the tree. 5. The map is sub-divided by full-stops, commas and brackets into sections corresponding to the major and minor sub-divisions of the branch system. 6. Successive censuses can be recorded one below the other on the same sheet, and the history of individual growths thus followed through the season and correlated with their performance next season and with their position on the tree. [Author's summary.] Examples are given of how the system can be worked in practice.

* For Part I see *Ibid.*, 1932, 10 : 228, *H.A.*, 1933, 3 : 1 : 17.

† See also abstract 524.

Soils, Manures, Cultural Practice.

551. Stephens, C. G. 634.11-1.4
The apple growing soils of Tasmania.
Part I.—A general investigation of the soils,
and,
Taylor, J. K., and Stephens, C. G. 634.11-1.4
Part 2.—A soil survey of part of the Huonville district.
Bull. Coun. sci. industr. Res. Aust., **92**, 1935, pp. 55.

In part I descriptions are given of ten soil types or groups of soils covering the apple growing regions throughout Tasmania. In part II the soils of the Huonville district, some 20 miles south of Hobart, and the largest single apple producing area in the state, are considered separately. In the general investigation the analyses made were mechanical, soil reactions and buffer curves, replaceable bases, and chemical. Except in cases where heavy applications of lime have been applied the soil reaction in all cases tended to be slightly acidic. Apples appear, however, to tolerate moderate acidity, and heavy liming is not advocated unless reactions remain below pH 5 or 5·5. The total content of replaceable bases for all surface soils was found to be reasonably good. Sodium was somewhat relatively high in some cases, but this is possibly explained by the common use of nitrate of soda. Potassium is generally low, but usually appears sufficient for tree requirements. Chemical analyses revealed fairly high nitrogen in most soils, and in general better tree growth was found in soils with higher contents. Phosphoric acid was generally low for all types, but appears to be sufficient in all cases for tree requirements. Potash on the other hand showed a weak but definite correlation with tree vigour. Of the ten soil types those promoting the strongest tree growth are alluvial soils, Huon silty loam, and Huon sandy loam, with next in order Mersey clay loam, Huon loam and Huon sand. On the remainder tree growth ranges from moderate to very poor. The occurrence of pit-like lesions in the fruit is characteristic to a variable degree of all the Huon soil types with exception of the Huon sandy loam. The presence of hard pan appears to increase the complaint, and the soils on which the fruit is most affected are those susceptible to waterlogging in winter and to drought in summer. Monthly and annual rainfall data are given for various areas, and from these it is evident that northern districts have lower summer and higher winter rainfall than southern. Annual rainfall at Franklin in the south for the last five years showed a minimum of approximately 27·5 inches and a maximum of 42·5 inches. In some areas variable summer rainfall necessitates irrigation in drier years. The text in both papers is accompanied by comprehensive tables, and by a map of Tasmania showing the apple growing areas under discussion. In addition there is a detailed soil map of the Huonville district.

552. Overley, F. L., and Overholser, E. L. 634.11-1.8
Progress report of fertilizer studies with Jonathan apples upon Ephrata fine sandy loam.
Bull. Wash. agric. Exp. Sta., **319**, 1935, pp. 34, bibl. 37.
and,
Progress report of fertilizer studies with apples.
Proc. Wash. Sta. hort. Ass. for 1934, 1935, **30** : 45-9.

Both papers describe the same experiment up to a similar stage in its development. The first only differs from the second in supplying tabulated evidence of results, in discussing them in greater detail, and in providing a review of American literature on previous experiments in apple fertilization. The apple manurial trial was started in 1927 in the east Wenatchee district. The following figures are quoted as representative of the number of pounds per acre of the three elements found in the top 10″ of soils in this district :—nitrogen 2,170, phosphoric acid 7,040, potash 42,900. The trees, which are Jonathans, were then about 18 years old, and of relatively uniform size and vigour. Prior to 1927 the orchard had received various nitrogenous dressings. Before 1922 it

was clean cultivated, and subsequently put down to a cover of alfalfa. With the exception of one year the cover crop has been disced under each spring, resulting in a gradually reduced stand until at present the cover consists of a limited quantity of alfalfa and a considerable number of weeds. The orchard was irrigated by the rill system. The fertilizers were applied during the winter except in the first year and the rates per tree were sulphate of ammonia 5 lb. (N), superphosphate 6 lb. (P), muriate of potash 5 lb. (K). 10 trees constituted a plot, but only the middle three were used for records. The fertilizers were applied in various combinations, each treatment, including a check receiving nothing (O), being represented by one plot. Results to date are as follows :—(1) Terminal growth :—N, NP, NK, NPK produced greater terminal growth than did O, P, K, or PK. N produced slightly more growth when P or K were excluded, and O resulted in more growth than when P and K or PK were added. (2) Average diameter of terminals showed a definite correlation with length. (3) Trunk circumference :—N, NP, NK, NPK gave somewhat greater increases than O. O equalled P or PK in most cases, but seemed to exceed K alone. (4) Winter killing of fruit buds :—No appreciable direct association was found. (5) Fruit set :—All combinations with N gave a higher percentage set than those without N. PK equalled O, but P or K separately were inferior. (6) Alternate bearing :—no consistent effects shown. (7) Number of young fruits removed at thinning :—same as for 5. (8) Yields :—same as for 5 and 7. (9) Fruit size :—N alone or in combinations tended to give larger fruit than O, and O than P and K alone or together. (10) Fruit colour :—P and K gave more red colour than O, and O than any combinations with N. It is suggested, however, that this effect is probably due to denser foliage in plots receiving N, and that sunlight and not the fertilizer is directly responsible. It would seem, therefore, advisable that in orchards, where a heavy leguminous cover crop cannot be maintained, an annual dressing of $\frac{1}{2}$ to 1 or occasionally more pounds of actual nitrogen should be added per tree. The dormant season is recommended as a suitable time, preferably on a snowfall if the ground is relatively level and not frozen.

553. Kroft, W. G. v.d. 634.1/7-1.8
Die Duengung der Obstkulturen. (**Manuring orchards in Holland.**) [French summary.]
Commun. 11ème Congr. Int. Hort. (Rome), 1935, pp. 8.
Study of fruit manurial problems by chemical analyses of plant organs or by pot experiments are not wholly satisfactory. Field experiments are more promising, but many obstacles arise which render interpretation difficult, and for this reason the study of manures is more backward in connexion with fruit growing than it is in other branches of agriculture. In Holland good and regular bearing has been obtained by a liberal application of the appropriate fertilizers, though it is recognized that the quantities will vary with the conditions. Excellent results have been obtained with the following applications per hectare per annum. Lime 1,000 kg., phosphoric acid 125 kg., potash 125-250 kg., nitrogen 100-150 kgs. [= approximately :—890, 111, 111-222, and 89-133 lb. per acre.—Ed.]

554. Rigg, T. 634.1/3-1.8
Fertilization of fruit trees (in New Zealand).
Commun. 11ème Congr. Int. Hort. (Rome), 1935, pp. 8.
In New Zealand the utilization of poor soils for apple culture has led to greater attention being paid to the manurial treatment of this fruit than in the case of stone, citrus or small fruits. Response of trees to manurial treatment naturally varies on different soils. Success has been obtained in the Moutere Hills district, where the soils are deficient in organic matter, nitrogen, lime and phosphate, by an annual sowing of blue lupin for ploughing in followed by an application of 3-4 lb. per tree of superphosphate or basic slag and 1 lb. per tree of muriate or sulphate of potash at time of ploughing and 2 lb. per tree ammonium sulphate 3 weeks before blossoming. One ton of ground limestone per acre every 4 years is recommended to improve the texture of the soil and to counteract acidity. Over a period of years at the Cawthron Institute 100% yield

increase over untreated plots has resulted from this treatment. A complete fertilizer always gave better results than any partial treatments. Boron deficiency has been shown to be responsible for a considerable incidence of corky pit in apples in the Nelson district.

555. Arndt, F. R. 631.67 : 634.1/8
Irrigation and drainage.
J. Dep. Agric. S. Aust., 1935, **39** : 58-69.
This is a general account of irrigation practices in orchards and vineyards, and the author discusses such aspects as the construction of main irrigation channels, methods of applying water such as the sprinkler system, flooding or furrow irrigation. He refers to the length of irrigation runs in connexion with the even distribution of water throughout the soil, and to the accumulation of alkali salts on either side of furrows due to the lateral movement of water, and he mentions the application of water in the form of flooding directly under the trees or vine trellis in order to leach these salts out for the root zone. Finally the connexion between drainage and alkali and seepage troubles, and the removal of surplus water by such cover crops as lucerne are discussed.

556. Claypool, L. L. 634.11-1.67
Irrigation of orchards.
Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 98-104.
The experiment described in this paper started at Prosser, Washington in 1930, was enlarged in 1932, and again in 1934. Its object was to determine the influence of different frequencies and amounts of irrigation water on the growth and cropping of three varieties of apples. The plots started in 1930 carried an old cover crop, and in these the penetration of water was good. The 1932 plots on the other hand were only seeded in 1931 and the penetration in these was poor. The soil was a light sandy loam. [Other details concerning management, tree size, climatic conditions, etc., are not given, and it is therefore difficult to assess the value of the quantitative results.—Ed.] The significance of irrigation practice in this area is, however, shown by the fact that 30-acre inches proved insufficient. The best responses were obtained from about 40-acre inches. Greater amounts than this produced little further improvement but did not, as might be expected, cause adverse effects, owing, it is thought, to rapid drainage. The same amount of water applied at intervals of 30 days proved more satisfactory than water applied at 15-day intervals. As regards terminal and trunk growth the effect of allowing soil moisture to fall below the wilting point, especially early in the season, was to reduce the ultimate amount of growth made. Yield and size of fruit also responded to an adequate water supply, and, in the case of yields, insufficient moisture seems to have established a marked biennial bearing tendency. As regards colour the amount of the water appears to be of no practical significance. In some years light irrigation has produced slightly more extensive colour, but heavier irrigation a better quality of colour.

557. Wickersham, C. P. 634.1/2-1.67
Orchard hillside irrigation with porous hose.
Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 97.
The writer of this article is a grower, and he describes very briefly his method of irrigating orchards situated on slopes too steep to allow efficient furrow irrigation. The water was conveyed to the point of application by a pipe or hose and from there applied to the soil through a 200 feet length of 8-ounce porous hose. With a back-up of 2-3 feet a 20-acre head or approximately 0·16 of a second foot can be forced through this length. The hose is laid on the level regardless of tree rows, and after 6-24 hours is disconnected and moved to a point between 8 and 30 feet further up the slope. Two 200 feet lengths were used to irrigate 15 acres, the greater part on four occasions during the season. The cost of the hose was high, viz. 5-6 cents per foot, but as against this the following advantages are claimed :—(1) saving of water, (2) more thorough irrigation, (3) the successful growth of a solid cover crop, (4) the absence of ditching costs and of reditching after cultivation, (5) reduction of labour costs by at least one-half.

558. ROBEY, O. E. 631.67 : 634.7
Using porous hose in high crops.
Quart. Bull. Mich. agric. Exp. Sta., 1935, **17** : 225-8.
The system of irrigation by means of a porous hose lying on the ground involves the moving of the hose from row to row at right angles to the main pipe line. In the case of vegetables and other field crops this offers little difficulty, but with so-called high row crops such as raspberries or currants the raising of the hose over the crop rows is objected to as cumbersome and liable to do damage to the plants. In this paper a simple device is described, whereby the hose can be moved endwise round a section of the row. The principle is that of a reel, and it has been effective in handling lengths of hose up to about 150 ft. Thus in rows up to 300 ft. the reel may be placed in the centre to move the hose round in two sections, but in rows longer than this two reels may be necessary.

559. SINGLETON, H. P. 634.1/2-1.67-1.874
Cover crops in irrigated orchards.
Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 94-6.
The forage legumes best suited for use in the irrigated valleys of Washington State are alfalfa and sweet-clover, the former to give a permanent stand and the latter a biennial. In the case of alfalfa the common southern strains are not sufficiently winter hardy. Northern strains are recommended and of these Ladak is a promising new variety. Grimm on the whole is inferior. Of the clovers Alpha appears to be rather more suitable than Grundy County White. The establishment of the cover crop needs considerable attention. A firm seed bed, carefully prepared, is essential. The rate of seeding lies between 10 lb. per acre for heavy soils and 15 lb. for light. Cross seeding in one direction gives greater uniformity. Immediately after sowing the ditches should be made, and the maximum distance between furrows should be 2 feet, but preferably less. Irrigation should be done sufficiently frequently till the plants come up so as never to let the surface soil dry completely. Subsequently drying should not be permitted to a greater depth than about one-fourth of the cover root system. In the case of clover weeds should be kept down by cutting at a height of 4-5 inches. The maintenance of the perennial alfalfa is also important. The value of the cover crop lies mainly in its ability to supply nitrogen to the soil, and the leaves, not the stems, are the main source of this supply. Thus the practice of discing, which is generally detrimental to the subsequent alfalfa stand, should not be done with the idea of incorporating a supply of organic nitrogen in the soil, but rather on the basis of eliminating fire danger, controlling weeds, helping to control orchard pests, or as a better preparation for other orchard practices.

560. DOTTI, F. 631.542 : 634.1/2
Potatura della chioma e delle radici al trapianto. (**Top and root pruning at transplanting.**)
Reprint from *Romagna agricola e zootecnica*, 1934, No. 11-12, pp. 32 (+ 18 pp. tables), bibl. 21.
The trials took place in 1932 and 1933 in the Provincial viticultural nurseries at Lugo. At the end of the winter 15 plants of 1-year-old seedling peach, 20 of 3-year-old crab apple 2 years in nursery bed, 20 of 3-year-old seedling pear 2 years in nursery, 15 of 2-year-old myrobolan 1 year in nursery, 20 2-year-old quince 1 year in nursery, and 17 of 2-year-old cherry 1 year in nursery, were very carefully removed from the beds, and were graded into 4 equal groups as uniform as possible, which were treated as follows :—(A) No pruning at all even of broken roots, (B) broken roots removed and largest roots shortened slightly, (C) ramifications of large roots removed but small fibrous roots retained, (D) large roots retained but fibrous ones, i.e. those below 3 mm. in diameter, removed. The tops were left intact. All were planted out in mid-February into a medium light fresh soil worked previously to a depth of 35 cm. and unmanured. Plants were set so as to receive equal illumination. After planting they were lopped at 60 cm. from ground level and side shoots were removed, only the central stem remaining. The only cultural operations performed were routine spraying and light hoeing. At the end of the

growing season stem girths were measured, the plants were pulled up and the year's growth cut off and weighed. In the second year the roots were either left intact or cut drastically to 1 cm. from their origin and 6 groups were formed according to whether the tops were not pruned or pruned slightly or pruned strongly at transplanting and whether roots were pruned or unpruned. The plants were allowed to grow as before and growth again estimated at the end of the growing season. The 2 years' results, which are also shown photographically and tabulated, may be summarized as follows :—(1) The best growth was made by groups in which roots remained untouched. (2) Where root pruning took place, the best growth resulted where the top was pruned proportionately. (3) Given identical root treatment, increment in growth in the first year after transplanting was directly correlated with amount of top left. The harder the tops were pruned, the smaller were the growth increments. (4) Given identical top treatment, growth increment exactly corresponded with the number of roots left intact on the plants. Smaller increments always resulted from severe root pruning. (5) No correlation could be established between growth increment in the year of transplanting and top : root ratio. The largest increment occurred when no pruning was done either of tops or roots. Plants with heavily pruned roots produced a greater growth increment where top growth was unrestricted than where top growth was most restricted.

561. Oskamp, J. 634.11-1.542

Investigations in pruning mature apple trees.

Bull. Cornell agric. Exp. Sta. **624**, 1935, pp. 42, bibl. 9.

Pruning experiments were started in 1928 in an orchard which had been planted in 1897. The trees used were standard Baldwin and Rhode Island Greening topworked on Northern Spy and set about 40 feet on the triangular system. Different rows were pruned in different years. The object was to remove such branches as would leave the remaining fruiting wood evenly distributed throughout the tree. The first pruning consisted either of large cuts, i.e. the removal of branches mainly larger than 1" in diameter, or of small cuts, i.e. the removal of branches mainly smaller than 1" in diameter. In the second pruning the treatments were always reversed, and in the third a combination of the two systems was used. Severity of pruning was estimated on a basis of the number of terminals or growing points of all lengths formed during the previous growing period and cut off during pruning. Heavy pruning implied the removal of 25% to 40% of the growing points at one time. Check trees were left unpruned. The effects of treatments upon growth and cropping together with the time required to prune each tree are tabulated in great detail. The results emphasize that the pruning of mature apple trees should be directed principally towards mechanical features. Yield, size, colour and freedom from injury do not appear to have been affected appreciably by pruning. The height of trees should be restricted to that at which a 20- or 22-foot ladder can be used for picking, which seems to be the economical limit. Where this is done the vigour of the lower limbs must be maintained by thinning branches to admit light. Where two branches are so close to each other that it is clear that they will later touch and rub, one of them should be removed at the earliest possible stage. Likewise when branches are parallel, and so close that their laterals may interfere with each other, one should be cut out. The removal of lateral branches starting from near the main trunk should, however, be moderated so as to avoid " skinning " the main limbs and leaving only an unbalanced fringe of fruiting wood at the outer side of the tree. Pruning every other year, if properly done, and preferably in " on " years, may be sufficient to fulfil these requirements, and may reduce costs in areas where pruning is only less costly than spraying.

562. Shaw, J. K. 634.11-1.542

Pruning bearing apple trees.

Bull. Mass. agric. Exp. Sta., **320**, 1935, pp. 16, bibl. in text.

The data collected in this paper concern two comparatively young bearing orchards planted in 1915 and 1916 respectively, one middle-aged orchard planted in 1897, and one old orchard planted in 1889. One of the younger orchards consists of one variety only and the remainder of four or five each. In all cases one treatment was no pruning apart from the removal of dead

and diseased branches, other treatments consisting mainly of prunings of different severity. Results are tabulated to show the effect of pruning upon trunk diameters, total and average yields and the grade and size of fruit. Figures for trunk diameters are variable, but do not appear to indicate any dwarfing effect through pruning. There are some indications that the pruning of young trees reduces yields in the earlier years, but that the balance is redressed later. Heavy pruning of older trees also appears to reduce yields. The effect of pruning, as against no pruning, on fruit size would not appear to be of much significance with trees in full vigour and production, but pruning markedly increases size on old trees declining in vigour. As regards diseases like scab which affect quality, there is no evidence that pruning makes spray treatments appreciably more effective, provided that modern spraying outfits of sufficient power and capacity are used. The process of picking, however, would seem to be distinctly easier on pruned trees. The only definite recommendations implied or stated appear to be that light or moderate pruning is preferable to no pruning or heavy pruning, that dead and dying wood in older trees should be cut out, and that weak and declining shoots should be similarly treated, as they are a source of much of the low-grade fruit. No discussion of the financial aspects of pruning is included, but the author states that " if one is forced to economize on labour, it is less injurious to neglect pruning than to cut down on spraying or neglect proper cultural treatment ".

Harvesting, etc.

563. Krone, B. 634.23-1.56

Grading and packing of cherries.

J. Dep. Agric. Vict., 1935, **33** : 499, 506, bibl. 2.

The Australian market requires firm hard cherries but fully mature. The fruit, therefore, should not be picked until it is fully developed but should be picked before it begins to soften. Grades should be Extra Fancy or Fancy. In Extra Fancy black varieties should be dark red or black, white varieties should be yellow over the whole surface, with a red flush, size of cherry not less than $\frac{7}{8}$ inch in diameter. In the " Fancy " both black and white varieties should have not less than $\frac{3}{4}$ of the surface coloured. Cherry size should be not less than 11/16th inch in diameter. The container used for these two grades is a wooden box $13\frac{3}{4}'' \times 10\frac{1}{8}'' \times 4''$ holding 12 lb., and this type of box should not be used for lower grades, or its association with a high-class article in the public mind will be lost. In packing the bottom layer (which subsequently becomes the top) the cherries are lifted by the stalks and placed in rows with the stalks upwards. The cherries for the other rows are simply filled in, being handled by the stalks only. Stalkless cherries are frequently sources of decay and should be discarded.

564. Hampson, C. C. 634.11 : 658.8

Cost of shipping point marketing services for apples in Washington.

Bull. Wash. agric. Exp. Sta., **312**, 1935, pp. 25.

The costs of the marketing services for apples performed at shipping points in Washington for the period 1922 to 1927 were published in *Bulletin* 242. The present paper is designed to bring this information up to date, and presents in detail the results of 12 years' study, from 1922 to 1933 inclusive. The figures given refer to costs to growers rather than to marketing organizations. The estimates are based on samples from the Wenatchee-Okanogan and Yakima districts. The apple sample at 24% of all apples shipped from the district represented a total of over 66 million boxes for the 12 years. The average total cost per box was 63·0 cents, the peak being 68·8 cents in 1927, after which a decline took place to 55·5 cents in 1933. On a percentage basis the cost was distributed as follows :—Packing services, labour, etc. 39% of the total shipping cost, boxes 23%, warehousing 11%, storage 10%, and selling 17%. The general trend during the last few years has been for all shipping point marketing costs with the exception of storage to decline. The 1933 estimated total of 55·5 cents per box is thus divided into :—Cost of packing services 19·9 cents, boxes 11·2 cents, warehousing or handling 6·3 cents, storage 9·1 cents which represents the peak, and selling 9·0 cents.

The following also are noted :—

Davis, L. D. **Some ash constituents of alternate-bearing sugar prune trees.**
Proc. Amer. Soc. hort. Sci. for 1934, 1935, **32** : 125-30, bibl. 8.

Overholser, E. L., and Overley, F. L. **The effect of spraying apple leaves with certain less used materials upon their carbon dioxide intake.** *Proc. Amer. Soc. hort. Sci. for 1934*, 1935, **32** : 93-6, bibl. 3.
Tompkins, L. E. **The effects of certain fertilizers upon the carbon dioxide intake of mature Jonathan apple leaves.** *Proc. Amer. Soc. hort. Sci. for 1934*, 1935, **32** : 97-100, bibl. 4.

SMALL FRUITS, VINES, NUTS.

565. Colby, A. S., Anderson, H. W., and Flint, W. P. 634.71
Bramble fruits. Raspberries—blackberries—dewberries.
Circ. Ill. agric. Exp. Sta., **427**, 1935, pp. 72.
This is divided into three parts. The first-named author contributes a comprehensive section upon bramble culture under Illinois conditions. The second provides a section on bramble diseases and their control, and the third one on bramble insects and their control. This paper should be of value not only to growers in that area of the United States, but to anybody interested in the cultivation of raspberries, blackberries, and dewberries elsewhere.

566. de Angeli, G. 634.75-1.544.4
Sulle temperature più adatte per la forzatura di fragaria Deutsch Ewern e Madame Lefèbre. (**On the best temperatures for forcing two strawberry varieties.**)
Ital. agric., 1935, **72** : 691-7, bibl. 6.
Work at Wageningen is described. Plants of both varieties were transferred from their ordinary open frames on November 5th to electrically heated frames in which the air temperature was kept at 13° C. and the soil temperature at a depth of 10 cm., 10° C. Such treatment, especially in Madame Lefèbre, greatly stimulated the emission of new buds and inflorescences. By appropriate closing and opening of apertures the air temperature was kept at about 6° C. during the first fortnight of December, after which it was increased daily by 1° C. up to 19° C. on December 29th. It was maintained at 19° C. till January 5th when both varieties were in full bloom. From January 5th the temperature was kept at 21° C. and it was expected to pick the first fruits on January 25th.

567. Davis, M. B. 634.76
The cranberry industry and its possibilities in Canada.
Bull. Canad. Dep. Agric., **180*** (n.s.), 1935, pp. 34.
The great majority of cranberries consumed in Canada are imported from the U.S., principally from the Cape Cod area. This paper describes in some detail the planting and cultivation of the large, or American, cranberry, *Vaccinium macrocarpon*, in the hope that it may be of assistance in encouraging the establishment of an enlarged home industry. A section on cranberry diseases is contributed by K. A. Harrison, and another on cranberry insects in Canada by F. C. Gilliatt.

568. C.S.I.R.Aust. 634.8
Viticultural Research Station (Nursery irrigation areas), Merbein, Victoria.
8th Annu. Rep. Coun. sci. industr. Res. Aust. for 1934, 1935, pp. 38-40.
Most of the station's activities are now systematic investigations designed to extend over a number of years. *Irrigation.* Excessive irrigation has resulted in certain areas becoming unproductive. By a study of " penetration " profiles it is practicable to determine the minimum efficient quantity of irrigation water. This determination is now being made on selected sites. The study of soil moisture changes during the inter-irrigation period is being continued. It has now been found that, where injurious salts occur as the result of irrigation, their incidence can

* Revised *Bull.* 19 (n.s.).

be decreased by effective control of distribution of irrigation water or by agricultural drainage. Drainage problems are being investigated. *Cultural problems.* The relation between yield and pruning practice of different vines under different environmental conditions is being studied and the best methods of reconstituting old vines damaged by pruning, bad seasons, ringing, etc., are under investigation. *Fruit processing.* Work so far in the first year of the investigation has consisted of a survey of existing field methods, the application of an electrical method for moisture determination in dried fruits, a study of fumigants for pests, colour changes during transport. *Control of dried fruit pests.* Regulations and inspections have now ensured that the whole export pack is successfully marketed. Further work is in progress on insect-proof containers, specially designed dried fruit boxes, pest control by fumigation and paraffin application. *Co-operation with State Departments and producers.* Work has included fruit processing, investigations in the non-irrigated vine areas of S. Australia and irrigation problems in S. Australia. It is noted that settlers are now abandoning the injurious habit of over-irrigation for systems of irrigation whereby only the minimum efficient quantities are given and are realizing the necessity for agricultural drains which are being installed comparatively rapidly in consequence.

569. RAVAZ, L. 634.8 : 663.2

Les facteurs de la qualité et les pratiques culturales. **(Factors of quality (in wine) and their relation to agricultural practice.)**

Progr. agric. vitic., **1935, 104** : 489-94.

The dominant factor in quality of wine is the vine variety. Muscat cannot be made without Muscat, Claret without Cabernet-Sauvignon or Burgundy without Pinot. And all varieties preserve their dominant characteristics no matter where or in what part of the world they are grown. French, Spanish, Portuguese, Swiss or German vines grown in California, North or South Africa, etc., still retain in their wines the chief characters for which they are renowned in their home countries. American grapes are no exception. Isabella for instance is universally foxy. Naturally, modifications occur, the most important being in connexion with the local conditions of vinification. Other influences also intervene, the principal of which are :— *Climate.* This influences maturity. Excessive maturity gives a tasteless, flat wine, while immaturity gives wines which are acid and almost undrinkable. Between the climates producing these two extremes there lie a whole range of others regional and local, and the latter again are modified by the situation of the vineyard, e.g. its position on flat, gently or steeply sloping land. Among all these there is an optimum for each particular vine. A cold climate for such vines as ripen under such conditions provides bouquet, flavour, and lightness, and such wines can be drunk at any hour of the day. Hot climates produce full bodied wines rich in alcohol and over-perfumed, or else harsh and heavy. Atmospheric humidity is an important factor in ripening. In Mexico at an altitude of 3,000 ft. grapes cannot ripen, not because of the lack of warmth but because of dryness of the atmosphere. *Soil.* Each vine variety has an optimum ripening period when it is at its best for harvesting. If this is hastened or retarded, the quality of the wine suffers. It is shown that the soil through its nutrients, colour and texture has a strong influence on the length of the ripening period. *Cultural operations.* The effect of manuring is discussed and the action of the different chemical manures is described. The danger of overmanuring and so producing too vigorous growth to the detriment of the wine is mentioned. Allusion is made to the practice of rejuvenation by "provining", in which the vine is buried in a trench on a bed of farm manure with only the ends of its branches protruding. These branches root. At first the grapes so produced are of mediocre quality but the vine soon settles down to produce its former high quality but with increased vigour. [This would not appear practical where there is any danger of phylloxera.—ED.] *Tillage.* The degree to which this is carried must depend entirely on circumstances. The author remarks that every wine merchant knows that couch grass can often be positively correlated with quality. *Pruning.* This must be so regulated that neither over- nor under-bearing occurs. It is necessary in hot countries so to contrive that the leaves shade the grapes, whereas in more temperate regions the grapes should be exposed. *Staking.* In hot countries the vines need not be staked. Left to themselves they produce numerous branches with the beneficial result that maturation is

retarded. In climates or varieties where maturity must be hastened by exposure a rectilinear training results in a reduced development of side shoots. *Tipping.* This practice is sometimes applied to the young shoots at flowering time to prevent fruit drop or later to control excess vegetation or to reduce shading.

570. COSMO, I. 634.851
Note ampelografiche di quattro uve nere precocissime. (**Notes on four very early black vines.**)
Ital. agric., 1935, **72** : 683-90, bibl. 7.

These notes refer to observations made at Conegliano on four vines, one being an introduction from Sardinia and the others crosses made by Pirovano. The morphological characters, dates of ripening and yields are considered. The first was introduced as S. Antoni, but was found in many respects to resemble closely Noir Hâtif de Marseille. The grapes ripen about a month before Chasselas Doré: they are not particularly attractive in appearance, but they have a pleasant muscat flavour and offer promise as table grapes for local consumption. The second, a Pirovano hybrid 14 (Bellino × Madeleine Angevine), ripens about the same date. It deserves trial as a dual purpose grape in cooler districts. Pirovano hybrid 15 (Bellino × Madeleine Angevine) offers more promise as a wine variety in cooler districts, its date of ripening being the same. Finally Pirovano 17 (Greco Bianco × Ischia Precoce) ripens in the North of Italy in August like all the above and might prove interesting both as a very early table grape and for wine in northern rainy districts, showing great resistance to *Peronospora*.

571. PIROVANO, A. 634.8-2.19
Sovratensioni critiche e colatura. (**Excessive tension and premature fruit fall with special reference to the vine.**)
Ital. agric., 1935, **72** : 179-82.

The author notes the fact that coulure (premature fruit fall) was very general in many parts of Italy in 1934. He considers that it was mainly due to excessive tension within the plant caused by its inability to get rid of moisture received from the soil. Three factors combined to bring this state about, namely, (1) excessive absorption from the soil which became warm earlier than vegetative growth was prepared for, (2) excessive air humidity due to frequent rain in warm weather followed by pronounced fall of temperature at night and dense morning mists and copious dew, (3) the chemical condition of the soil, especially with regard to the nitrates present during the period of maximum activity of cell division in fruits just in process of forming or setting. These circumstances combined to prevent proper elimination of moisture in the plant, to obstruct seriously gaseous exchange and to bring circulation to a standstill, thereby stopping nutrients from reaching the fruits, which accordingly fell off. It was noticeable that varieties most prone to this disaster were those of sub-tropical origin. These may be considered as slightly xerophilous and unable to cope with excessive air humidity at this period of growth. Many other varieties, however, may also show the same tendency to cast their fruits under such circumstances. Sometimes the various Chasselas strains will do so, if the soil is too rich. In general the author considers that vines with a tough fibrous stem show less tendency to fruit fall than others, and that the morphology of the leaves may also play an important part and merits investigation on the point.

572. DOTTI, F. 634.8-1.546
Il problema dei tutori della vite in Romagna di fronte alla morìa degli olmi. (**The best vine supports in view of elm disease.**)
Reprint from *Romagna agricola e zootecnica*, 1935, Nos. 8-9, pp. 44.

The trees most generally used for vine supports in Romagna (Northern Italy) are the elm, the maple, the poplar, and occasionally the willow. Very serious loss has been caused among the elms by the attacks of *Graphium ulmi*, and the considerations which should influence anyone whose elm supports are dying or who wishes to plant a vineyard and use the most economical supports for his vines are here set out. Measurements made in different parts of the province

and under differing soil conditions show that vines grow more quickly and better when the maple, *Acer campestris*, is used in preference to one of the elms, and reasons are given why this tree should be used in preference to elm, poplar or willow where elm disease necessitates replacement of support or in new plantings, if it is still wished to use living supports. Experiments, however, by Dotti and others suggest very strongly that inert supports of a durable nature such as reinforced concrete have many advantages over those used at present and that despite their greater initial cost and the necessity for using somewhat larger quantities of supporting wire they can be recommended for use in the future. For anyone wanting to compare the merits of the trees mentioned and of reinforced concrete, or how to substitute the Siberian elm (immune to *Graphium*) or the maple or a concrete post for the present living support this article should prove an extremely interesting and satisfactory guide.

573. FOTHERINGHAM, N. S., AND OTHERS. 634.8-1.542

Experiments in the pruning of sultana vines in relation to crop returns—result of six years' trials at Berri.

Bull. Dep. Agric. S. Aust., **304**, 1935, pp. 138-45.

The results of a six years' competition on the pruning of trellised sultana vines are summarized in this paper. Differences between total crop returns and methods of pruning of the competitors were too slight to be of much value, but the trials have emphasized certain aspects of good pruning practice. Probably the most important consideration is the relationship of fruiting wood to yield and vine vigour. On fairly large, healthy vines, it is suggested that six strong fruiting canes carrying about 72 well-developed buds should be sufficient to provide a 2 ton crop of dried fruit per acre. In any case a smaller number of these strong fruiting canes should be left in preference to a larger number of weaker canes with smaller buds. On weaker vines fewer fruiting canes should be left, and vice versa. Excessive pruning encourages vegetative growth at the expense of fruit, whereas too light pruning may increase crops in earlier years at the expense of future vigour. Finally pruning should be done carefully to avoid such injury as may be made by saw cuts on the main arms of the vines.

574. HAMOND, J. B. 634.51

Recent developments in walnut growing in England.

J. roy. hort. Soc., 1935, **60** : 501-7, bibl. 8.

It is only within the last ten years that attention has been turned to the possibility of establishing satisfactory commercial walnut trees in this country. In this article the investigations carried out at East Malling Research Station and the progress made are outlined. These have involved experiments in the vegetative propagation of rootstocks, and in the budding and grafting of selected varieties on to these stocks. In addition to providing large trees of the usual standard type certain trees have been selected and reserved in an attempt to obtain bush trees with an earlier bearing habit. The demand for grafted trees has in the last few years far exceeded the supply, and appears to be still increasing. In an attempt to meet this demand four nursery firms were supplied for the first time with a nucleus of young grafted trees in 1934. Investigations into the storage of walnuts in a fresh condition during the winter have also been carried out, and the means of keeping the nuts from October until at any rate the following May appear to be established. Two diseases, bacterial blight caused by *Pseudomonas Juglandis*, and graft disease caused by *Chalaropsis thielavioides* with appropriate control measures are described, and finally a very brief account is given of the more important features in walnut cultivation. [More detailed descriptions of the various investigations noted in this paper may be obtained by reference to the literature cited in the bibliography.—ED.]

575. NEILSON, J. A. 634.51-2.111

The relation of geographic strain to hardiness in English walnut.

Quart. Bull. Mich. agric. Exp. Sta., 1935, **18** : 15-22.

The autumn of 1933 was exceptionally warm and moist in Michigan, and the growth of walnut trees continued much later than normally, the wood failing to ripen properly before winter set in. The winter itself was abnormally cold and did a great deal of damage to English walnuts. A

careful examination was subsequently made of individual trees and several small plantations in a number of districts in which the lowest temperatures recorded during the season had ranged between −30° and −15° F. Winter injury was found to take two forms, the killing back of branches, and the killing of bark, the latter being due to splitting, desiccation, or both. The killing back of branches was evident in every tree except the hardiest types of Polish or Russian origin. The survey revealed that the cultivated varieties of French origin or descent as represented by Mayette, Franquette, and Seando, were virtually annihilated in young plantations. The Broadview, a new variety from Canada and of Russian parentage, suffered only slight killing back in some cases, but was otherwise uninjured. The McDermid, another Canadian variety, also showed no serious injury. A strain of Carpathian walnut from S.E. Poland, which has been named Crath, also proved very hardy. So-called Pomeroy seedlings from New York on the other hand suffered severely, as did a number of trees of direct English origin. The Chinese walnut is a geographic form of the so-called English walnut, but trees from the northernmost range of this type are considered somewhat hardier than the original parent. A very limited number of these trees in Michigan survived the frost comparatively well. In the case of grafted trees of all types the common rootstock appears to have been the hardy black walnut, so that possible stock effect or resistance to frost injury is not recorded. In order to guard against injury from low winter temperatures the following suggestions are put forward :—(1) Plant only the hardiest varieties. (2) Drain all walnut soils thoroughly, as this appears to lessen late growth. (3) and (4) Use nitrogenous fertilizers in moderation, and avoid cultivating soil round the trees late in the summer because both tend to stimulate late growth.

576. Nast, C. G. 634.51 : 581.145.2
Morphological development of the fruit of *Juglans regia*.
Hilgardia, 1935, **9** : 345-62, bibl. 19, plts. 19.
The authoress traces the morphological and anatomical development of the fruit of the walnut, *Juglans regia* L., in great detail from the flower stage to full maturity, and illustrates her text with nineteen very clear plates.

577. Crane, H. L., and others. 634.521-1.542.27
Effect of nut thinning on size, degree of filling, and annual yields of pecans.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, **32** : 29-32.
The limited data obtained from thinning the nuts of a few trees during " on years " indicate that the practice may increase the size and degree of filling of the nuts and also the bloom in the following year.

578. Crane, H. L., and others. 634.521-1.542.27
Growth and yield of pecan trees, as affected by thinning the stand of trees and other orchard practices.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, **32** : 33-7, bibl. 1.
Thinning a stand of 24-year-old pecan trees to 10 per acre giving a spacing of about 93 feet on the quincunx system resulted in marked yield increases per tree and larger nuts than in the check plot, in which the trees stood about 47 feet on the square. Moreover on an acre basis the yields were approximately the same in both plots after two years. The addition of 30 lb. sulphate of ammonia per tree, half in March and half in May, to a second close planted plot also increased the yield, but not the size of the nuts, and the yield increase was not sufficient to pay for the cost of the fertilizer. Heavy pruning of the close planted trees encouraged better shoot growth than any other treatment, but resulted in no crops at all in the first year and practically none the second.

579. Gleisberg, W. 634.574 : 631.541.11 +581.162.3
Antep fistiği. (**Pistache problems.**) [Turkish.]
Ziraat Gazetesi, 1935, **6** : 230-4.
Rootstock and pollination problems of the pistache were investigated on a journey to the Turkish pistache district of Gazi Aintap, Kilis and Nizip on the Syrian frontier. The rootstocks

normally used in these parts are seedlings of *Pistacia terebinthus* or *P. vera*. *P. terebinthus* seedlings vary in vigour but are generally speaking weak growing. Pistache varieties worked on them flower earlier than those on *P. vera*. They thrive on poor soil and are capable of crop production on the dry mountain sides of the district. *P. vera* seedlings need deeper soils. They are more vigorous in growth than *P. terebinthus*. Fruit production is, however, initiated later when *P. vera* is the rootstock. In view of the fact that a better take is obtained with *P. vera*, it is suggested that they should be used in nurseries in preference to *P. terebinthus*. The rootstock problem is one of those confronting the state nursery at Gazi Aintap. A further important task is the raising of a sufficient number of male pistache trees to ensure better pollination results in the district, since the peasants have destroyed a large number of these necessary trees. It is suggested that when close planting 1 male tree for every 10 females should suffice, but when planting fairly wide apart 1 male should be present to every 5 females. A sub-station of the Ankara Horticultural Institute is to be established at Gazi Aintap for the study of flower biology in the different forms of the cultivated pistache. The layout of this station—which will incidentally also deal with rootstock problems—is discussed. W.G. [Author.]

580. LUTRI, I. 634.55 : 581.162.3
Indagine sull'autosterilità e sull'autofertilità del mandorlo. (**A study of self-sterility and self-fertility in the almond.**)
Ital. agric., 1935, **72** : 139-55, bibl. 5.

An examination of 7 almond varieties commonly grown in Southern Italy revealed the fact that one of them, Avola Scelta, is for practical purposes quite self-sterile, but that two of the other common varieties, namely Romana and Albicoccara Grossa, are excellent pollinators of it. The two latter together with Albicoccara Piccola are found to be self-fertile, but to benefit considerably from cross pollination. Pizzutella, Mollese and Fascionello are self-sterile and need cross pollination.

The following also are noted :—

GOUDE, H. **The cultivation of the blackberry.** *Advis. Leafit. Norfolk C.C.*, 6, 1935, pp. 7.

FINCH, A. H. **Further notes on pecan filling and maturity.** *Proc. Amer. Soc. hort. Sci. for 1934*, 1935, **32** : 24-8.

PLANT PROTECTION OF DECIDUOUS FRUITS.*

581. YOUNG, P. A. 632.951.8 : 634.11
Decane ring-spot of apple leaves, and symptoms of decane injury in apple, potato and onion.
Amer. J. Bot., 1935, **22** : 629-34.

Drops of synthetic n-decane ($C_{10}H_{22}$), one of the hydrocarbons in petroleum oils, were placed on leaves of apple, potato, and onion to compare its effects with those of undiluted petroleum oils. On apple leaves ring-spots were formed in 5 to 30 seconds. These turned brown within a few hours, and later the upper surfaces of many spots turned white. In the centre of the rings of dead tissue green islands remained alive for many days afterwards. Young apple leaves and dormant buds were killed by decane and cankers developed on their twigs. No increase in toxicity, however, was found when 50% of decane was added to a petroleum insecticidal spray, and only one of the petroleum oils tested formed ring-spots similar to decane. Drops of decane placed on potato leaves killed the treated areas, and passed into the stems where it occupied spaces between the parenchyma cells, but did not form ring-spots. Onion leaves were also penetrated, the decane passing into the roots, and again lodging between parenchyma cells.

* See also 685-7.

582. Blair, D. S. 634.11-2.111
Winter injury to apple trees in Eastern Canada, 1933-5.
Sci. Agric., 1935, **16** : 8-15.

The severe winter of 1933-4 did damage which reduced the output of apples from the provinces of Ontario and Quebec in 1934 by 60·5% and 70% respectively. Many forms of winter killing were observed, the principal being, (1) trunk injury, (2) crotch injury, (3) sunscald, (4) bark splitting, (5) killing of dormant buds, (6) killing back, (7) black heart, (8) discoloration of sapwood, (9) trunk splitting. These may be conveniently assembled into two classes, (1) injury to leaf and fruit buds, (2) injury to wood tissues above the ground. The extensive injury is attributed to an early frost in November (from 9° F. above zero in Nova Scotia to 5° F. below zero in Quebec) occurring before the trees were properly hardened off, followed by the coldest winter on record. This last factor was mainly responsible for the complete killing of many trees by desiccation. The late immaturity of the wood in the previous autumn was due to a premature dormancy resulting from a dry summer being followed by a second growth on the advent of a warm and wet autumn. Trees which had cropped heavily died, whilst those without a crop survived. Crotch injury was common, for the tissues composing the crotch mature relatively slowly compared with other parts of the tree. In each case losses seem to be associated with lack of carbohydrates. A statistical study of injury at the Central Experimental Farm, Ottawa, revealed (1) marked injury due to a low lying position with insufficient air drainage ; (2) the superior hardiness of Crimson Beauty and Lobo over all other varieties ; (3) lack of rootstock influence on hardiness between Malling types 2, 9, 16, Quaker Beauty seedling, *Pyrus robusta* seedling and French Crab within a significant difference of 16·38% (significant odds 19 : 1). The relative hardiness of various apples grown in Canada is discussed and the need for hardy late winter apples of high quality is pointed out. The work of Saunders and his successors in the breeding of hardy types, using the Siberian crab as the original seed parent, is briefly described. At the present time there are ten 3rd crosses of this descent which passed through the winter of 1933-4 without injury and give every indication of being of great commercial value. (The present number of 3rd crosses is 615, of which only 91 have yet come into bearing.) A method of building a hardy framework by double working stocks of hardy Russian varieties such as Antonovka, before finally budding with commercial varieties, is advocated. These varieties never suffer any of the winter injuries which affect ordinary commercial varieties, many of which are lost through trunk or crotch injury. Trees so worked come through in a much better condition than on their own trunk and scaffolds. The procedure would be to sow seed of Antonovka, Anis, Charlamoff or *Pyrus baccata* hybrids in say 1935, and plant them out in nursery rows in the autumn of 1936. In July or August the seedlings would be budded with Antonovka, Anis or Charlamoff, necessary to ensure uniform hardiness of trunk. In 1938 the bud would have developed into a one-year-old whip for planting in its permanent position in the spring of 1939. It would then be trained to 5 or 6 main branches, arranged spirally round the trunk about 8 inches apart, the first beginning at 30 inches from the ground. By 1941 these main scaffolds would be sufficiently large, and from that date two would be budded every year, 18 inches from the trunk, with a standard commercial variety, the whole process being complete by 1944 when a tree of hardy rootstock, trunk and main branches would have been formed.

583. Rawes, A. N. 634.1/2-2.111
Orchard-heating experiments at Wisley, May 1935.
J. roy. hort. Soc., 1935, **60** : 508-9.

200 " Harrington " orchard heaters were tested on the night of May 17th in a situation regarded as a frost hole. The crops were bush and half-standard apples interplanted with strawberries and black currants. 50 heaters were employed per acre, and each lamp contained 2 gals. oil, which was sufficient for 8 hours' burning. It took approximately ¾ hour for two men to ignite the 200 lamps at about 10 p.m. In the heated area at 7 a.m., 6 degrees F. of frost were registered, whereas in a control area there were 12 degrees of frost. The night was somewhat windy and a few trees were slightly scorched, although no serious damage was done. Two further observations are noted. Refilling the heaters with liquid fuel is a slow and laborious work unless

specially adjusted filling tanks are available, and in this connexion it appears that solid fuel briquettes, such as are used in the U.S., are not yet to be found in England. Secondly the smoke from the heaters forms a deposit of greasy soot on neighbouring trees and buildings. Insufficiency of oil prevented a repetition of the treatment on subsequent nights, and as frosts of 5 and 9 degrees were registered on the 18th and 19th May respectively, the top fruits in the area were practically a total loss.

584. Anderson, L. C. 634.23-1.541.11-2.111
A survey of the behaviour of cherry trees in the Hudson River Valley with particular reference to losses from winter killing and other causes.
Bull. N.Y. agric. Exp. Sta. **653**, 1935, pp. 23.

Following the unusually cold winter of 1933/4, in which minimum temperatures of −20° to −35° F. were recorded in various localities in the Hudson River Valley, a survey was made of cherry orchards to determine the influence of the two rootstocks, Mazzard and Mahaleb, upon the damage done. Deaths were divided as to those attributable to freezing, and those for which other causes were responsible. Amongst sour cherries orchards of Montmorency and Morello, and amongst sweet cherries orchards of Black Tartarian, Schmidt, Windsor, Lambert and Seneca on both stocks were examined. A number of other varieties on Mazzard were also surveyed. The results indicate that both sweet and sour cherries on Mazzard suffered somewhat more severely from freezing than did those on Mahaleb. Injuries and mortalities were most pronounced in light sandy soils, low in organic matter, and particularly in the case of young trees. The direct cause was killing of the surface roots, which occurred even in older trees. Large vigorous trees on Mazzard, on stronger well-drained soils, suffered very little. Poorly-drained orchards tended to show severe winter killing regardless of stock. Trees on Mahaleb suffered less from freezing than did those on Mazzard, but when deaths from other causes were taken into account the annual losses on Mahaleb were shown to be much the greater. Dry seasons are held to be chiefly responsible in these cases. Thus, apart from a consideration of exceptionally cold winters, Mazzard is the stock recommended for general use. Winter injury to the tops was more prevalent in sweet than in sour cherries, and was most noticeable in Black Tartarian. It was rare, however, for this injury to be sufficient to cause death.

585. Woods, J. J. 634.711-2.111-1.8
Availability of nutrients in raspberry plots in relation to winter injury.
Sci. Agric., 1935, **16** : 1-7, bibl. 10.

In the winter of 1932-3 unusual weather conditions, consisting of a sudden drop in temperature following exceptionally mild weather in October, November and early December, resulted in plantations of Cuthbert raspberry in British Columbia being more severely injured than ever before. The injury consisted of withering and shrivelling of the affected parts. In the spring of 1933, when bud growth had finally ceased, attempts were made to record the injury by counting the living and dead canes on each plot at Agassiz Experiment Station. It was found that plots receiving farmyard manure, complete artificial fertilizer or clean cultivation suffered considerably greater injury than plots treated with rye, clover or vetch. The injured plots were those showing the most vigorous growth and the most pronounced branching. Branching is a most consistent habit of the Cuthbert variety under good cultivation. Throughout the plots branched plants were more injured than unbranched. More injury was caused to the crown and root systems on plots where nutrients were most plentiful. The manurial requirements of the raspberry are discussed.

586. Ballard, W. S., and Lindner, R. C. 632.19 : 634.1/8
Studies of the little-leaf disease in California.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, **32** : 1-10, bibl. 13.

A definite association appears to exist between apple rosette, pecan rosette, and the little-leaf diseases of stone fruits, grapes, and various other woody plants, but experiments covering a period of about 10 years have failed to determine any specific cause. The belief that the disease

is not caused by a parasite or virus is supported by an experiment in which 35 diseased grape vines were transplanted to a different locality and recovered completely within two years. In the same way healthy vines replacing diseased vines and other affected plants regrafted with healthy shoots soon developed little-leaf, whereas cuttings rooted from diseased vines and placed in fertile potting soil rapidly lost all symptoms of little-leaf. It has been observed that trees and vines growing on the sites of old barn-yards or stock feeding grounds frequently show marked symptoms of the disease. The name corral spots is commonly used to describe these areas, and the term " corral spot sickness " applied to unhealthy trees appears to be synonymous with little-leaf. One such area in which the original peach trees had died or been grubbed on account of the disease, was planted up with various trees in the spring of 1931. In July 1934 the percentages of trees affected by little-leaf or rosette were :—Kelsey Japan plum on peach stock 100%, seedling pecan 100%, Muir peach on peach 92%, Yellow Egg plum on peach 75%, Early Harvest apple on seedling apple 50%, Paynes seedling walnut 25%, own-rooted Malaga grapes 23%. The effect of cover cropping with alfalfa in a vineyard has been noted in another experiment. In the clean cultivated area the percentage of plants showing some little-leaf increased progressively in three seasons, whilst in the cover-cropped area a progressive decrease occurred. Chemical treatments with a number of materials including iron sulphate and zinc sulphate have been tested, principally on grapes and plums. The results indicate that the disease can be corrected by introducing a sufficient quantity of zinc either by means of soil applications, injections, or by spraying. Results with iron sulphate applied to the soil were very inconsistent, and any improvements shown in certain cases are thought to be associated with zinc impurities in the material, or with the tendency shown by some vines to show marked little-leaf one year and practically none the next. When zinc sulphate is applied to the soil the dormant season would appear to be the most suitable, because during the growing season it may cause serious foliage injury. The amount of zinc sulphate applied in injections will apparently vary with the plant to be treated. Apricots showed marked improvement, but slight foliage burning, with doses of 0·60 to 1·80 grams. Vines injected at ground level showed no ill effects from 15 grams. For spray purposes zinc sulphate alone is liable to cause injury, and appears to be best combined at about 6 ounces with zinc oxide or zinc sulphide at 10 lb., plus casein spreader to 50 gallons water. 3 lb. zinc sulphate with 5 pints strong ammonia water in 50 gallons water gave the best results for pecans sprayed in August.

587. Chandler, W. H., and others. 632.19 : 634.1/8

Little-leaf or rosette of fruit trees. IV.

Proc. Amer. Soc. hort. Sci. for 1934, 1935, **32** : 11-9, bibl. 3.

The results of previous experiments* are reviewed in the light of subsequent work. Tests with materials, other than zinc or certain zinc salts, have failed to promote any recovery from little-leaf. When zinc sulphate is applied to the soil, the amount necessary will depend partly on the size of the tree, but very largely on soil fixing power for zinc. Where this fixing power is high as in nearly all California soils the treatment may prove too expensive. Spraying young foliage with a zinc-lime mixture, usually about 10 lb. zinc sulphate, 5 lb. hydrated lime in 100 gals. water, has produced marked response in peaches, plums, grapes, apricots, and citrus, especially the two last, but not in walnuts. Very similar results have been obtained from spraying the mature autumn leaves with 16 to 32 lb. zinc sulphate, with or without lime, walnuts again being the exception. Brushing grape vines just after pruning with a strong zinc sulphate solution of 2 lb. to the gallon of water also produced recovery. The pruning wound appears to be essential, because brushing just before pruning gave only very slight responses. On trees this treatment was much less effective. Zinc-coated nails and pieces of zinc driven into the wood 1″ apart around the circumference checked little-leaf in peach, plum, apricot, apple, grapes and most walnut trees. Pieces of zinc as small as No. 2 glaziers' points ¼″ were found to be adequate,

* Previous articles have appeared : *Ibid. for 1931*, 1932, 28 : 556-60 (*H.A.*, 1932, 2 : 3 : 240), *Ibid. for 1932*, 1933, 29 : 255-63 (*H.A.*, 1934, 4 : 3 : 354), and *Ibid. for 1933*, 1934, 30, 70-86 (*H.A.*, 1934, 4 : 3 : 354).

but between 4 and 7 of these to 1″ circumference were needed to cure rapidly some of the larger walnut trees. Citrus trees responded very slowly or not at all to this treatment. Before recommendations can be made regarding the use of zinc pieces, which may become completely buried beneath the bark in a few months, evidence must be found concerning the possibility of zinc injury, and the length of time the treatment may be expected to last.

588. McWhorter, O. T. 634.23-2.19

Response of sweet cherry trees to zinc sulphate treatment for little-leaf at The Dalles.

Rep. Ore. hort. Soc. for 1934, 1935, pp. 56-8.

Sweet cherry trees showing symptoms of " little-leaf " or " rosette " to a marked degree were treated with zinc sulphate early in 1933. Holes $\frac{3}{8}$″ in diameter and $1\frac{1}{2}$″ deep were bored in the trunks just below the ground line, and sloping slightly downwards. In some cases these were spaced at 4″ all around the trunk, and in others only through half the circumference. Pure powdered zinc sulphate was applied to each cavity up to within $\frac{1}{4}$″ of the surface, care being taken to avoid contact between the chemical and the bark. The holes were then plugged with grafting wax. Within 30 days improved foliage colour was manifested, but in the case of the trees injected on only one half of the trunk, the untreated side of each tree appears to have shown no improvement. In the following year the fully treated trees showed almost complete recovery. Similar results were obtained with trees of the variety Gold Drop, which were injected in July 1933 after the crop was removed. One of these latter trees was reinjected in the spring of 1934 using the same holes as were used in the first injection, and throughout 1934 this tree appeared healthier than the once-treated trees. It is therefore thought that increased dosages might be used to advantage, and for this purpose, in experiments to be made in 1935, the diameter of the holes bored in the trunks is to be increased from $\frac{3}{8}$″ to $\frac{1}{2}$″.

589. Isaac, W. E. 634.1/7-2.191

Researches on the chlorosis of deciduous fruit trees. I. Preliminary. II. Experiments on chlorosis of peach trees.

Trans. roy. Soc. S. Afr., 1934, **22**, part 3, pp. 171-86, bibl. 41, and 187-204, bibl. 20.

In part I the literature on the subject is reviewed, and the various factors associated with the appearance of chlorosis in plants are discussed. In part II an investigation into the treatment of chlorotic young peach trees is described. Out of 3,000 trees planted in 1932 about 500 soon began to show serious chlorosis. The symptoms were characteristic. In most cases it was the lower leaves which were affected, and the ground tissue of these became from pale green to yellow in colour, leaving the midrib and major pinnate veins a normal green. Examination showed that the trouble tended to start at the tip and work backwards along the margins. Many affected leaves later developed small reddish-brown or copper coloured spots, and sometimes large copper coloured areas in which spots of light brown, dead tissue appeared. As, however, similar discoloured and necrotic areas were found upon otherwise normal leaves, it seems probable that the condition of trees was due to at least two distinct causes. The trees were divided into groups based on the severity of chlorosis. Each treatment (application to soil) was applied in the spring to several trees belonging to the different groups, and in the autumn regrouping was done to note the effects. In analysing results a tendency was noted for some of the untreated control trees to outgrow the chlorosis, while at the same time the number of trees classed as badly affected also increased. Of the treatment results, by far the most significant are those obtained from the use of copper sulphate. Concentrations of 5 p.p.m. and 10 p.p.m. produced improvements, and one of 20 p.p.m. almost complete disappearance of chlorosis. The latter represents in this case about 1·33 ounces per tree. An application of manganese sulphate and potassium sulphate also produced marked improvement, but the use of manganese sulphate alone or with lime, sulphur, sodium nitrate, or superphosphate brought about no significant change for the good, and it is, therefore, held that potash was the agent responsible. The lack of response to manganese was surprising, because the percentage in the

soil over the whole area was found to be low, but more particularly so in areas showing severe chlorosis. Likewise the possibility that the unhealthy condition of the trees might be due to toxic concentrations of available aluminium, iron or manganese is discounted, because additions of lime alone and with other substances aggravated the chlorosis. The application of sulphur alone brought about an improvement in the intravascular chlorosis of the lower leaves, but the foliage as a whole remained a rather unhealthy, light green colour and there was no tendency to check necrosis. Finally, soil analyses indicate that the trees are not suffering from magnesium deficiency. The experiment just described is of a preliminary nature, and further investigations are to be carried out on the relations of copper and potassium sulphate to chlorosis in peach trees, and in addition the effects of zinc and magnesium, and of lime, both on chlorotic and on normal trees in the same area, are to be tested.

590. Quinn, G. 634.11-1.541.11-2.8

The state experiment orchard, Coromandel Valley, near Blackwood, South Australia. Rootstocks in relation to the occurrence of bitter pit in apples.

J. Dep. Agric. S. Aust., 1935, **39** : 46-57 and 234-61.

The publication last year of an " Annotated bibliography on bitter pit " by this Bureau* has prompted the author to contribute his experiences from a series of trials carried out with apple trees since 1908. The three rootstocks used were Northern Spy, the type commercially adopted throughout Australia and reputed to bear fruits which are badly affected by bitter pit, Winter Majetin, and Cole's Blightproof Paradise, the two latter having fruits reputed to be very free from bitter pit. All three are considered " blight proof ", i.e. resistant to woolly aphis. In addition a number of trees on Northern Spy were double-worked with intermediates of Winter Majetin and Cole's Paradise or with stem-pieces of three commercial varieties, Dunn's Seedling, Rokewood, and Rome Beauty, which also had a reputation for resistance to bitter pit. Finally six varieties were grown as scions on these various combinations, namely Baldwin, Cleopatra (syn. Ortley of U.S.A.), Cleopatra Q, Esopus Spitzenburg, Jonathan and Shockley. Direct quantitative comparison based on aggregates has not been possible for several reasons. The number of trees has not been the same for each treatment ; the number of harvests recorded range from 19 to 23, some trees having been planted several years earlier than others, and some dropped from the trials before others on account of topworking ; and lastly in the case of Rome Beauty used as an intermediate on Northern Spy the subvariety Cleopatra Q was omitted altogether. Measurements have, however, been collected from the 82 trees in the trial to give averages for rootstock girths, intermediate stem-pieces, trunks, and height and spread. The use of Dunn's Seedling, Rokewood and Rome Beauty as intermediates on Northern Spy, and of Cole's Paradise as a stock, have produced trees of similar dimensions to those grown direct on Northern Spy. The reputation of Cole's Paradise as a dwarfing rootstock, at any rate on deep fertile soils, is not therefore maintained. Winter Majetin either as rootstock or intermediate, and Cole's Paradise as intermediate, gave consistently smaller trees than did Northern Spy. Records of bitter pit infection show a gradual increase up to about 16 years from the date of planting, and after that a rapid decline. Trees grafted on Northern Spy produced a distinctly higher proportion of apples affected by bitter pit than did trees on the two other stocks, but against this Winter Majetin and Cole's Paradise in general induced poor cropping. The author states that these trials show that under local conditions of soil and climate " the commercial varieties of apple-trees grown on Northern Spy rootstocks, or on Dunn's Seedling, Rokewood, or Rome Beauty stem-pieces superimposed upon Northern Spy roots, consistently produced crops, which, after the whole of the bitter pit affected apples were eliminated, surpassed in quantity and value the total yields of the same varieties grown on Winter Majetin, or Cole's Paradise rootstocks or stem-pieces ". The six-scion varieties are also listed according to the percentage of bitter pit affected apples produced by each over 19 to 23 consecutive years :—Jonathan 3·30, Esopus Spitzenburg 8·33, Cleopatra 16·59, Cleopatra Q 17·82, Shockley 24·55, and Baldwin 33·41.

* Annotated bibliography on bitter pit. *Occas. Pap. Imp. Bur. Fruit Prod.*, 3, 1934.

591. Harley, C. P. 634.11-2.19

Water-core.

Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 105-8, bibl. 1.

Water-core, a disorder of developing apple fruits, is primarily caused by high temperatures such as are produced by direct exposure to sunlight. A high leaf to fruit ratio and high soil nitrogen are contributory factors. Chemical analyses have shown that the changes occurring in the localized water-core tissues are identical with the normal maturing or ripening processes, but that they proceed at a much more rapid rate than in the adjacent normal tissues. Apples with the vascular type of water-core, or with only small areas scattered throughout the tissue, seem, however, to be capable of recovery with little or no apparent ill effects on their storage life. Since the main cause of the disorder is firstly temperature, which cannot be regulated, and secondly high nitrogen, which is essential for the production of large crops, the question of control is a difficult one. It is, however, possible to reduce the incidence by careful propping so as not to alter the positions of the fruiting branches and thereby expose shaded fruits to the sun. Fruits exposed from the start are more resistant to water-core or to sunburn. Careful pruning and fruit thinning will reduce the necessity for the use of props.

592. Miller, P. W. 634.51-2.314

Studies on the control of walnut blight in Oregon : fifth report of progress.

Proc. 20th Annu. Meeting Western Nut Growers Ass. for 1934, 1935, pp. 105-21.

The application of a sufficient number of timely bordeaux mixture treatments has been shown during the earlier years of the present study to reduce blight infection on the nuts to negligible proportions in orchards of uniform variety from grafted stock. The results of current investigations may be summarized as follows :—(1) *The number and timing of applications*—2 sprays, one just before and one immediately after bloom reduced infection to 1% as compared with 46% on untreated trees. The use of 3 or 4 applications covering similar dates in two of the sprays gave no better results than this, and the use of one or two applications at different dates gave inferior control. (2) *Proper strength of the spray mixture*—Two applications of $1\frac{1}{2}$-$1\frac{1}{2}$-50 bordeaux gave results practically as good as did stronger mixtures, but there is a possibility that in years of severe blight this may prove too weak, and so the formulae recommended are 2-2-50 or 3-3-50. (3) *Effect of spraying on crop yield*—Three applications of 3-3-50 bordeaux produced substantial increases both in wet and dry weights of nuts per tree over the control. (4) *Effect of spraying on quality*—Nuts from sprayed plots appeared to be definitely superior to those from unsprayed trees. The proportions of culls, misshapen and blight-spotted nuts were distinctly lower. These results in all cases accord with those obtained in previous years. Past studies have indicated that the control of blight by spraying is a much more difficult matter in seedling orchards owing to the great variation in the individual periods of blooming. In 1934, however, a seedling orchard was sprayed with excellent results. The best control (2·1% nuts infected against 73·2% from untreated trees) was obtained from 5 applications of bordeaux, 3 pre-bloom and 2 post-bloom, but almost as satisfactory control (3·5% infected) was achieved with only 3 sprays, 2 pre- and 1 post-bloom. It is considered, however, that the degree of control secured in seedling orchards will be dependent very largely upon the prompt application of sprays to individual trees at the right stage in development. A comparison of several dusts with bordeaux showed none superior nor even equal to two applications of the spray. Leaf injury associated with bordeaux was another aspect of the problem studied. Among several formulae two applications of 2-2-50 caused some injury and of 3-3-50 considerable injury, whilst the same spraying programme with 2-8-50 did no detectable damage. Certain disadvantages of a high lime, bordeaux mixture are, however, held to outweigh the advantage of reduced injury. The addition of oils of several kinds to bordeaux also apparently prevented damage, and these combinations are considered promising. Finally, a number of other copper containing preparations were tried, all of which caused no injury, and, although none gave such complete control of blight as bordeaux, some are considered worthy of extended trial. Of these the most promising is basic copper sulphate, which is relatively cheap, and is very easily prepared.

Reference to earlier progress reports on these blight control investigations may be found in *H.A.*, 1933, 3 : 2 : 190 and *H.A.*, 1934, 4 : 2 : 223.

593. Noble, R. J., and others. 632.3/4
Plant diseases recorded in New South Wales.
Sci. Bull. Dep. Agric. N.S.W., **46**, 1934, pp. 47.
Over 1,260 plant diseases occurring in N.S.W. are listed in sections headed by the generic names of plants. All entries are in alphabetical order, fungi and bacteria genera and species being noted under each plant species. Where possible the earliest date upon which each disease was recorded is given. A plant disease survey, started in 1924, has established the existence of the majority of the diseases listed, but a few doubtful cases collected from earlier literature are still included. Diseases of major importance affecting economic crops are denoted by asterisks. An index is provided containing the common names of host plants, the genera of bacteria, fungi, and nematodes, and of virus, non-parasitic, and undetermined diseases.

594. Noble, R. J. 634.1/7-2.4
A few notes on diseases of fruits, etc., and on problems associated with them (Australia).
Commun. 11 ème Congr. Int. Hort. (Rome), 1935, pp. 5.
The most serious diseases are briefly reported on :—*Pome fruits*. Black spot or scab (*Venturia inaequalis* and *V. pyrina*) are the most serious fungus diseases but may be satisfactorily controlled by applications of bordeaux followed later by lime-sulphur. The non-parasitic diseases of internal cork, water-core, crinkle and pit are also of great importance. *Stone fruits*. Brown rot (*Sclerotinia fructicola*) has been dealt with fairly efficiently by the use of bordeaux 6 : 4 : 22 (as a dormant spray) followed by lime-sulphur at 1% polysulphide concentrations at pink bud, petal fall, again one month later and finally 3-4 weeks before ripening. The combination of colloidal sulphur and ordinary lime-sulphur is of value in New Zealand but requires caution in Australia. *Citrus*. The principal citrus infection is black spot (*Phoma citricarpa*). Infection occurs in the early growth stages of the fruit, but lesions may not develop until approximately 9-12 months later. Spraying with bordeaux 6 : 4 : 80 at late blossoming and subsequently 6-8 weeks later will effect control, but to the detriment of fruit size and colour and apparently leading to increased scale infestation. Lime-sulphurs are effective but the large number of applications necessary is a commercial disadvantage. Colloidal coppers and other sprays containing copper are also unsatisfactory. Detailed tests involving the removal of affected fruits before blossoming are being made. *Sprays*. The polysulphide content of lime-sulphur preparations is a matter of interest. It is felt that the summer strength of commercial preparations could be considerably reduced with a consequent saving of spraying costs and a reduction of injury.

595. Paillot, M. A. 632.95 : 634.11 +634.13
Traitements fongicides et insecticides des poiriers et pommiers. (**Fungicidal and insecticidal treatments of pears and apples.**)
Commun. 11 ème Congr. Int. Hort. (Rome), 1935, pp. 6.
A useful combined winter fungicide and insecticide can be made by the addition of anthracene oil to bordeaux mixtures. The formula recommended is copper sulphate in powder form 2 kgs., hydrated lime 3 kgs., anthracene oil 10 litres, casein 75 grs., water 90 litres. The oil is added after the bordeaux mixture has been prepared. The addition of arsenate has also proved beneficial in controlling *Anthonomus*.

596. Goodwin, W., and others. 634.11-2.42
The control of apple scab ; Allington Pippin and Newton Wonder, 1934.*
J.S.E. agric. Coll. Wye, 1935, No. **36**, pp. 55-61.
Attacks of scab were slight and late compared with those of previous years, the unsprayed plots showing over 60% of scab-free apples of both varieties. Both cotton seed oil-bordeaux and

* See *Ibid.*, 1933, 32 : 95 and 1934, 34 : 136, *H.A.*, 1933, 3 : 3 : 329 and 1934, 4 : 3 : 379.

ordinary bordeaux effectively reduced scab infection in both varieties, but under the conditions of comparatively trifling infection it was impossible to find any difference in the fungicidal efficiency of the two sprays. The indication given previously that cotton seed oil-bordeaux caused less russetting was not confirmed.

597. Schmidt, M. 632.42 : 634.11
Venturia inaequalis (Cooke) Aderh. IV. Weitere Beiträge zur Rassenfrage beim Erreger des Apfelschorfes. (**Further notes on the question of strains in the apple scab fungus.**)
Gartenbauwiss., 1935, **9** : 364-89, bibl. 7.

The author describes a careful study of the different forms of conidia grown in culture medium from material taken from different patches of infection on the leaves of a single tree each of Belle de Boskoop, Cox's Orange Pippin and *Malus baccata*. 100 single spore cultures coming from 18-20 different leaves were isolated from each of the above. They were inoculated on Pulstagar in petri dishes and their development under identical conditions was noted. 35 different morphological types were isolated from the Belle de Boskoop, 53 from Cox and 23 from *Malus baccata*. In each case the same morphological type was generally found more than once on different leaves, but in no case was it identical with any type found on the other hosts. The type remained unchanged even after transplanting to and growing on a different host. These different types contain, it is thought, different genetical factors and preparations are now being made to investigate this theory, the first step being the culture on artificial media of ripe asci. What factors determine the particular nature of the strains living on any given host will also be investigated. It can already be stated that no direct connexion exists between the morphological specialization of *V. inaequalis* and its physiological specializations on a particular host.

598. Rudloff, C. F., and Schmidt, M. 632.42 : 634.11
Der Erreger des Apfelschorfes, *Venturia inaequalis* (Cooke) Aderh. Grundlagen u. Möglichkeiten für seine Bekämpfung auf züchterischem Wege. I. Sammelreferat. (**The apple scab fungus and the possibility of its control by breeding methods. A review of the present position.**)
Züchter, 1935, **7** : 30-7, bibl. 51.

An exhaustive study of *V. inaequalis*, its morphology, physiology, habits and preferences must precede any serious attempt to breed resistant apple varieties. The authors in this article summarize our present knowledge on these points. The following important facts are dealt with :—*Life history* (1) parasitic stage, (2) saprophytic stage, (3) the position and orientation of perithecia on the leaf. *Methods of infection and theories thereon* (1) conditions necessary for the growth and ripening of perithecia and ascospores, (2) the emptying of the asci and spread of the ascospores, (3) the importance of twig scab in primary infection, (4) conidia and their importance in the spread of the fungus during the growing season, (5) spore germination and the process of infection. *Factors influencing the severity of attack* (1) environmental factors especially weather, (2) susceptibility of the host, which may vary according to variety, age of tree, development and age of different parts of tree, etc.

599. Rudloff, C. F., and Schmidt, M. 632.42 : 634.11
Der Erreger des Apfelschorfes, *Venturia inaequalis* (Cooke) Aderh. Grundlagen und Möglichkeiten für seine Bekämpfung auf züchterischem Wege. II. (**Apple scab. The possibility of control by breeding methods. II.**)
Züchter, 1935, **7** : 65-74, bibl. as for previous article (Abst. 598).

This is a continuation of the previous article. In it the authors discuss the basis on which any attempts to select resistant varieties of apples must be based. They note that definite conclusions necessitate previous artificial infection trials with the fungus. They then deal with available knowledge on the following points :—(1) Growth of the fungus in artificial media and the retention there of its virulence. (2) The technique of artificial infection. (3) The varying susceptibility

of apple varieties and *Malus* species to scab. (4) Factors influencing the degree of susceptibility. (5) Strain formation in *V. inaequalis* and the question of the incidence of biotypes. Finally, the chief steps necessary for the production of resistant apple varieties are briefly considered. The aim is to combine scab resistance with other good commercial qualities. Very strongly resistant varieties are known and these can be crossed with varieties lacking scab resistance, but otherwise showing excellent qualities. Trial of the resulting seedlings will be done in 3 stages, viz. :—(1) Large numbers of seedlings will be submitted for 1 or 2 years to mass infection trials. (2) Clones of these surviving this test will then under controlled conditions be submitted to individual infection tests. (3) Survivors will be planted out to test their resistance and incidentally commercial qualities in the field. The second stage necessitates (1) the possibility of obtaining rooted cuttings [or presumably clone material by some method. The authors refer to a method devised by von Riebesel—i.e. root nurse grafting, see Abst. 536 of this number.—Ed.], (2) the production of a reliable infection method, and (3) the retention of the virulence of the fungus in culture media. The problem of different biotypes and the possibly differing resistance of apple varieties to such types still needs investigation. Rudloff's own work (*Gartenbauwiss.*, 1934, 9 : 64-91 noted *H.A.*, 1934, 4 : 4 : 560) on the retention of virulence in different media has done much to clear up the question of biotypes and the same author again has given details of a mass infection trial in *Züchter*, 1934, 6 : 11-2.

600. Dotti, F. 632.42 : 634.11/13

Ticchiolatura del melo e polisolfuro. (**Scab and lime sulphur.**)
Publ. Catt. amb. Agric. Prov. Ravenna, **1934**, pp. 20, bibl. 10,
and,
Studio sull' efficacia del polisolfuro e della poltigia bordolese nella lotta contro la *Venturia inaequalis*. (**Lime sulphur versus bordeaux for scab control.**)
Reprint from *Romagna agricola e zootecnica*, **1935**, No. 3, pp. 36.

In the first of these bulletins the author describes the methods of preparing lime-sulphur and the proper times for applying it. He considers that most cases of scorching attributed to its use have been due to lack of knowledge or lack of care, though he notes that a look-out must be kept for such varieties of fruit as will not stand it at all, Doyenne de Comice among pears, and Winter Calville Blanche among apples being in that category. In the second he contrasts experimental results from bordeaux and lime-sulphur in the spring and summer of 1934 and notes the following points :—*Scab control.* With regard to apple scab control was, generally speaking, equally good in both cases. *Scorching.* The only two bad cases of scorching occurred after using lime-sulphur, but the cause of this was evidently too high concentration and lack of sufficient lime. Otherwise no scorching occurred in either case, but the foliage of the lime-sulphur trees appeared much fresher in summer and autumn than that of the bordeaux trees and leaf fall occurred appreciably earlier after bordeaux than after lime-sulphur. *Mildew.* No mildew was found on lime-sulphur trees, whereas on the control and bordeaux trees it did appreciable damage. *Russetting.* This was much worse after bordeaux in the case of Reinette of Canada, Calville Blanche, Black Ben Davis and Rosa Mantovana, but in Durello was less than after lime-sulphur. The author notes also that lime-sulphur has, unlike bordeaux, an excellent deterrent effect on scale insects and *Tingis pyri.*

601. Ashcroft, J. M. 632.42 : 634.51

European canker of black walnut and other trees.
Bull. W. Va. agric. Exp. Sta. **261**, **1934**, pp. 52, bibl. 58.

The destructive disease known as "European Canker" appears to be widespread on black walnut in West Virginia, and had been found in eight other states and in one province of Canada. It is caused by a fungus, which appears to require a wound at the point of infection. The first symptom is the appearance of rough, sunken or flattened depressions on the trunk or branches. In more advanced stages the cankers are characterized by a number of prominent ridges of callus wood arranged more or less concentrically around the central area of infection. As the cankers spread each year, successive ridges of callus are killed and the ridging effect resembles

terracing. Eventually branches are completely girdled, and the part of the tree above this point dies. In addition to the black walnut, *Juglans nigra*, similar cankers have been found on *Acer rubrum*, *Liriodendron tulipifera*, *Juglans cinerea*, *Quercus rubra*, *Q. alba*, *Q. velutina*, and *Hicoria glabra*. In each case a *Nectria* species has been found associated with the cankers, and inoculation tests described here prove the pathogenicity of each strain for its respective host. Furthermore, cross-inoculation experiments have shown that all these *Nectrias* can infect black walnut, and that the black walnut organism can infect the other plants concerned. The morphological characters of the *Nectrias* are described, and on a basis of these all have been referred to *Nectria galligena Bres.* Detailed descriptions of the pathological anatomy incident to the disease on black walnut and of the manner in which the cankers are formed are also given. Control measures are summarized briefly. Badly cankered trees should be cut down, and all infected parts burned. In less severe cases branches may be removed and burnt, or cankers cut out to expose healthy tissue. Wounds made in cutting should be covered with a protective material such as asphaltum, white lead, or bordeaux paste. Since high temperatures may kill or inhibit further development of the fungus, it is suggested that planting sites and spacing should be selected with a view to obtaining maximum exposure to the sun. Finally, alternative host trees in the neighbourhood should be examined, and where possible the disease eradicated from them.

602. KOCH, L. W. 634.22-2.42

Investigations on black knot of plums and cherries. II. The occurrence and significance of certain fungi found in association with *Dibotryon morbosum* (Sch.) T. & S.

Sci. Agric., 1934, **15** : 80-95, bibl. 18.

Experiments have indicated that *Cephalothecium roseum* Corda exerts an important measure of natural biologic control over *Dibotryon morbosum*, the black knot fungus. It appears consistently in July and August on the conidial-bearing stroma and destroys the perithecial initials, occasionally to the extent of inhibiting perithecia completely on infected knots. A number of other fungi frequently isolated from black knots are mentioned, but none is an imperfect stage of *D. morbosum*. A *Coniothyrium* species is described which is capable of causing slight swellings, but not typical knots, and which, when grown in culture with *D. morbosum*, exhibits mutual tolerance. It is not, however, genetically connected with *D. morbosum*.

603. KOCH, L. W. 632.42 : 634.22 +634.23

Investigations on black knot of plums and cherries. IV.† Studies in pathogenicity and pathological histology.

Sci. Agric., 1935, **15** : 729-43, bibl. 13.

In his introduction the author states :—" In this article, concluding the present investigations on black knot, studies on pathogenicity and pathological histology of the host are the two major phases under consideration, while varietal susceptibility and certain experiments in control are dealt with in a minor way." The causal agent of black knot is the fungus *Dibotryon morbosum*, which exhibits a high type of parasitism, in that host and parasite are able to live in intimate contact for approximately 6-7 months before any ill effects appear. A wide range of both wild and cultivated species of *Prunus* in Canada and the U.S. are susceptible to the disease. The degree of susceptibility of the different varieties of plums and cherries cannot, however, be established, because very marked differences are shown in various districts. This would appear to indicate the existence of physiologic forms of the fungus, some of which are non-existent in certain areas. The use of " delayed dormant " application of 1 : 8 lime-sulphur followed by further sprays of the same fungicide at 1 : 50 about the time of bud break was recommended in an earlier paper.* Recent experiments have indicated that excellent control of black knot can be obtained by an additional application of lime-sulphur at 1 : 50 during full bloom.

* *Ibid.*, Investigations on black knot of plums and cherries. I. Development and discharge of spores and experiments in control. *Sci. Agric.*, 1933, 13 : 576-90, *H.A.*, 1933, 3 : 3 : 334).

† Part III deals solely with symptomatology, *Ibid.*, 1935, 15 : 411-23.

604. McNew, G. L., and Bliss, D. E. 634.23-2.4
Control of cherry yellow-leaf on nursery stock.
Bull. Ia. agric. Exp. Sta., **332**, 1935, 155-84, bibl. 13.

Yellow-leaf caused by the fungus, *Coccomyces hiemalis* Higgins, is stated to be the most prevalent and destructive cherry disease in Iowa. A description of the disease and its life history are given here. It results in early defoliation with consequent reduction in growth during the current and subsequent seasons, and its occurrence in nurseries precludes all possibility of forcing the trees into marketable size in one growing season. Some 30 spraying and dusting materials have been tested at different times over a number of years. All fungicides, which did not prove seriously injurious to young trees, gave some measure of control, but only home-made bordeaux mixture at 4-6-50 showed profitable and consistent results. There was a tendency for bordeaux and some other sprays to retard growth, but trees so treated grew better than those which were not sprayed at all. Kolodust, a sulphur dust, did not appear to retard growth, and in one season proved satisfactory, but it failed when applied during a period of heavy rainfall. The use of spreaders such as casein fluxit fixator, rosin-fish oil or oil emulsion enhanced the effectiveness of bordeaux. Dusts are more easily removed by rain than sprays, and their use seems to be confined to seasons of light infection. In normal years nursery spraying should be done about once every 10 days from the time the plants are 6-12 inches high until almost the end of the growing season.

605. Illinois Hort. Dep. 632.94
Directions for spraying fruits in Illinois.
Circ. Ill. agric. Exp. Sta., **429**, 1935, pp. 24.

This paper is a revision of *Circular* 388 by W. P. Flint. It is divided into four parts. The first deals briefly with some general facts about insects, diseases and spraying. The second provides recommended local spray schedules for apples, pears, peaches, sour cherries, plums, brambles, currants and gooseberries, grapes and strawberries. Thirdly methods for preparing and mixing the following spray materials are described :—Boiled lubricating oil emulsion, cold-mixed oil emulsions, bordeaux, zinc sulphate and lime, wettable sulphur, and more briefly dry-mix sulphur-lime, lead arsenate, bordeaux and lead arsenate, lime, lime-sulphur and lead arsenate, and nicotine sulphate. Finally notes are given on the following commercial preparations :—Commercial liquid lime-sulphur, dry lime-sulphur, wettable ground sulphurs, flotation sulphur, summer oil emulsions, miscible oils, and tar washes.

606. Davies, C., and Smyth-Homewood, G. R. B. 632.94
Investigations on machinery used in spraying. Part II.* Nozzles.
J.S.E. agric. Coll., Wye, 1935, No. **36**, pp. 62-85, bibl. 5.

Celluloid discs† (used as artificial leaves) were hung in selected places among branches of apple trees subjected to normal spray-treatment. The spray deposited on them was eventually measured for area covered (by means of a specially-devised transparent screen, a photo-electric-cell technique proving unsatisfactory) and judged for uniformity of cover and degree of atomization. Combining all three, an average " cover-efficiency " of 62% was obtained under known conditions of pump-pressure and nozzle-setting. Experiments in the field to determine the influence of different pump-pressures and nozzle-settings on the area covered gave inconclusive results. Different types of nozzle were subjected to many tests, some of which required special apparatus, which is described. The results confirmed previous findings.* The merits and demerits of multiple nozzles are discussed, and suggestions made for the most effective disposition of each in the set. The paper contains eleven plates, seven text figures and three tables.

M.H.M.

* Part I appeared *Ibid.*, 1934, No. 34, pp. 39-62, *H.A.*, 1934, 4 : 3 : 385.

† Described *Ibid.*, 1934, No. 34, pp. 252-3, *H.A.*, 1934, 4 : 3 : 386.

607. MOUTIA, A. 632.7 : 634/5
The commoner insect pests of orchards, vegetable and flower gardens in Mauritius.
Gen. Ser. Bull. Dep. Agric. Mauritius, **44**, 1935, pp. 39.
Following a short general outline of the biology of insects, the more important pests in Mauritius are grouped under their respective orders, a description being given in each case and recommended control measures listed. A section is devoted to methods of combating insects, and the formulae for, and preparation of, a large number of insecticides, baits, and repellents are outlined. The insects mentioned in the text are listed with their host or host plants in one of three appendices, and in another the various fruit trees, ornamental plants and flowers, and vegetables are tabulated with their pest or pests and the part or parts of the plant affected. This paper should prove of value and interest to entomologists working in all parts of the tropics.

608. YOTHERS, M. A. 634.11-2.753-2.96
Report on the introduction of *Aphelinus mali* Hald. a parasite of the woolly apple aphid, in the Wenatchee, Washington, district.
Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 68-71.
During the summer of 1931 the parasite *Aphelinus mali* Hald. was introduced in order to discover to what extent it might control the woolly aphid, *Eriosoma lanigerum* Hald. on apple trees. The parasites were multiplied in a large, cloth-covered cage, constructed over a young Delicious tree, which was badly infested with woolly aphis. From June to September the numbers increased very rapidly, and the first liberations were made at the end of the latter month. *Aphelinus* now appears to be established over hundreds of acres of orchards, and its percentage of parasitism has steadily increased up to the present year, 1934, so that in some orchards it has already effectively checked the aphid.

609. CHIAROMONTE, A. 632.96
Un vasto programma di lotta biologica contro insetti dannosi e piante infestanti in agricoltura. **(Biological control, a far-reaching programme.)**
Agricoltura colon., 1935, **29** : 437-49.
The author gives here the gist of an article by Professor Silvestri published in *Italia agricola* in February 1933 on biological control and notes that Silvestri also dealt with the subject thoroughly in his lectures at the University of London in 1932 (published in *J.S.E. agric. Coll., Wye*, 1932, No. 30, pp. 87-96, *H.A.*, 1932, 2 : 3 : 254). It is interesting as showing where biological control is being tested. In most cases the work is still in its infancy, and the difficulties and at the same time possibilities of such control are only now being realized for the first time.

610. GRAM, E., AND STAPEL, C. 632.951.4 : 632.7 +632.4
Forsøg med Foraarskarbolineum. **(Experiments with spring carbolineums.)**
Medd. Forsøgsv. Plantek. Kbh., **242**, 1935, pp. 3.
Results are given of tests carried out in Denmark with so-called spring carbolineums, sold under the names Abolin, Krimpol and Mentin, against certain pests of apple trees and against apple blossom wilt. No appreciable damage was caused to the trees, even though the later applications were made towards the end of April when the buds were very swollen and showed 3 to 4 mm. of green tip. The preparations were used mostly at a strength of 10%. Against red spider they were mixed with water, in the other cases with bordeaux mixture (2 : 1 : 100) or bouisol (½%). Good control was obtained against apple blossom weevil (*Anthonomus pomorum*) and apple sucker (*Psylla mali*), and promising results against winter moth (*Operophtera brumata*), tortrix and red spider. Trials were carried out against apple blossom wilt (*Sclerotinia laxa* f. *mali*) in the spring of 1934 and again in 1935. In one experiment untreated trees showed 8 or 9% wilted blossom trusses, whilst on the sprayed trees the attack was reduced to 1-2%. When these spring carbolineums were mixed with water only, the results against apple blossom wilt were inferior to those obtained when the preparations were used in combination with bordeaux mixture. They can be used with lime-sulphur also but the control appears to be less effective.
H.W.

611. Cormack, A. B. 632.951.1 : 631.535

The vegetative propagation of pyrethrum.

J.S.E. agric. Coll., Wye, 1935, **36** : pp. 33-7.

Difficulties in harvesting [*Ibidem*, 1932, 30: 183, *H.A.*, 1932, 2 : 3 : 242] suggested the experiments here described. [It may also be noted that Martin and Tattersfield have already determined that selection followed by vegetative propagation can also improve insecticidal properties. *Ann. appl. Biol.*, 1934, 21 : 670, *H.A.*, 1935, 5 : 1 : 54.—Ed.] Six representative plants were selected and split up, the divided clonal stocks being replanted. Of these one clone showed the following features, which tend to facilitate harvesting : Erect and compact habit, equal spread of inflorescences and leaves, all flowers about same distance from ground, early flowering. Further work is in progress with this clone, which at the time of writing was only in its second year of growth, and a number of cuttings planted in pots appeared to be growing quite as well as seedlings in March 1935. Experiments with a stool from the main crop led the author to the following conclusions :—Pyrethrum can be propagated vegetatively by crown shoots, soft shoot cuttings and root cuttings. The cuttings are raised more easily in a cool house than in the open. A 5-year-old plant will produce from 75 to 100 soft shoot cuttings, a divided plant after 2 years' growth 30 to 50. Relatively more root cuttings, but fewer soft shoot cuttings were got from a 2-year-old than from a 5-year-old plant. The date of planting is important and cuttings strike better in the early part of the growing season. Propagation by cuttings is a practical way of increasing stocks.

612. Jaffray, A. B. 632.951.1

A note on the evaluation of Australian grown pyrethrum flowers.

J. Coun. sci. industr. Res. Aust., 1935, **8** : 231-3.

An account is given of the determination of the pyrethrin I. content by the rapid, acid method evolved by Tattersfield, Hobson and Gimingham. This consists essentially in extracting the pyrethrins with low boiling petrol ether, hydrolyzing these by boiling with methyl alcoholic sodium hydroxide, and then acidifying and steam distilling. The acid resulting from the hydrolysis of the pyrethrin I. passes over readily with the steam, while that from pyrethrin II. is non-volatile in steam and remains in the flask. The distillate is shaken out with petrol ether, which is titrated with N/50 sodium hydroxide in a stoppered bottle with vigorous shaking. In the Australian tests which are here described in detail, extraction of the flowers of 4 strains was made for 6 hours. To test whether 6 hours might perhaps be too short or too long a period of extraction, one sample was also extracted for $8\frac{3}{4}$ hours and one for $5\frac{1}{2}$ hours, but results showed reasonable agreement in all cases. Further, in view of the incomplete extraction obtained in certain cases with petrol ether where the material was not very finely powdered, a trial was made also of extracting with acetone. In two cases out of three there was approximate agreement with the figures given by petrol ether extraction, in the third the acetone figures were considerably lower.

613. Fleming, W. E., and Baker, F. E. 632.76 : 632.944

The use of carbon disulphide* against the Japanese beetle.

Tech. Bull. U.S. Dep. Agric. **478**, 1935, pp. 91, bibl. 166.

The enforcement of an embargo on the outward movement of nursery products and certain fruits to restrict the spread of the Japanese beetle, *Popillia japonica* Newman, would have caused serious hardship to nurserymen and growers within the infested area owing to the wide range of plants and fruits involved. It was, therefore, decided that shipments might be made, provided that consignments could be certified as having been treated to remove or destroy infestation. The present paper deals very comprehensively with an investigation on the uses of carbon disulphide for this purpose and draws attention to much work done elsewhere on the same chemical. The vapour is toxic to all stages of the insect, egg, pupa, larva and adult in ascending order of susceptibility, but the concentration needed will depend upon the stage

* For other control methods see *H.A.*, 1934, 4 : 4 : 582-5.

present. The same quantity of carbon disulphide in the form of an emulsion is about half as effective as the vapour. Soil treatment before planting appears to benefit subsequent growth, but when plants are present there is danger of severe injury or killing unless the concentration of vapour or emulsion is carefully controlled. Potting soil may be fumigated in a box or bin with commercial (U.S.P. or C.P. grades) carbon disulphide at an injection rate of 1 lb. per cubic yard. The temperature should be at least 45° F. and at no time below 40° F. The container should be sealed for at least 48 hours. In plots a rate of 6 lb. per 100 sq. feet is suggested, when the chemical should be applied in holes 1-2″ deep and 12″ apart, and the temperature as above. Where a stock (49-51%) emulsion is used, the solution should be applied at a rate of 2·5 gallons per sq. foot. Where the soil around plants for export is to be treated, a collar should be scooped out and the emulsion poured into this and left undisturbed for 48 hours. The area treated should be greater than that to be used for balling the roots. Plants should be dug up from 2 to 5 days after treatment. Periods when adult beetles are present are unsuitable unless the plots are protected from them. A list of various species of ornamental shrubs which have been successfully treated with the emulsion is given, and also certain plants which cannot be treated on account of injury. A dip of stock carbon disulphide emulsion diluted at a rate of 45 cc. to 10 gals. water was effective when the root systems of several varieties of herbaceous and deciduous plants were submerged for about 24 hours at a constant temperature of 70° F. Evergreens were, however, injured by insecticidal concentrations. For the other types the dormant season would appear to be the safest. The use of a diluted emulsion for treating potted plants is also effective, but is considered too slow and expensive for practical purposes. Various fruits harvested during the summer periods when the adult Japanese beetle is in flight have been known to carry this insect when packed for market. Inspection is laborious and often injurious to the fruit, and as a possible alternative tests were made with carbon disulphide fumigation on four blueberry varieties, two strawberry varieties, and one variety each of raspberry, blackberry, red currant, gooseberry, peach and plum. With the possible exception of two blueberry varieties no appreciable difference in keeping quality could be attributed to the treatment. The recommended concentration is 1 lb. commercial carbon disulphide for every 100 cubic feet of space. The temperature should be 80° F., and the room should be sealed for 2 hours.

614. Dotti, F. 632.952.1 : 632.951.23

Polisolfuri e arseniati considerati in miscela. **(Should polysulphides and arsenates be mixed ?)**

Reprint from *Romagna agricola e zootecnica*, 1934, vol. **28**, no. 10, pp. 12.

An examination of the chemical results of mixing lime-sulphur and lead arsenate, together with many years' practical experience of chemists and fruitgrowers alike shows that the practice is a desirable and proper one. The reasons for this conclusion are here set out.

615. Haller, M. H., and others. 634.11-2.951.23

Spray-residue removal from apples and other fruits.

Fmrs.' Bull. U.S. Dep. Agric., **1752**, 1935, pp. 25.

The U.S. 1935 tolerances for spray residues are :—0·01 grain arsenic as arsenic trioxide, 0·01 grain fluorine, and 0·018 grain lead per pound of fruit. This paper outlines methods of spray residue removal by washing. With *apples* the problem is associated mainly with codling moth control, and is more acute in the warm irrigated areas of the Pacific Northwest than in the central and eastern states, partly because the former are more favourable to the moth and thus more sprays are applied, and partly because there are fewer summer rains to help to wash residues off the fruit. Moreover, fewer fungicides containing lime are required in the northwest, where scab and bitter rot are less prevalent, a factor detrimental to the efficiency of acid washing solutions, though making alkaline solutions relatively more effective. Thus the problem differs very considerably in different climatic areas, and is further complicated by annual variations, the nature of the spray mixtures, and the varieties concerned. Two types of washing solution are discussed. Hydrochloric acid (HCl) is particularly suitable for alkaline residues, as where lime

has been added, and fluorine residues. The concentration ranges from 0·5 to 1·5% by weight (a 1% solution requires about 2·8 gallons 20% HCl of specific gravity 1·16 to 100 gallons water). The time of exposure of the fruit ranges from 30 to 120 seconds according to the washing machine and the concentration. The effectiveness of the solution may be increased by raising the temperature to between 90° and 110° F., especially where waxy or oily deposits are present. The addition of 1-3% common salt to HCl solutions may assist in removing arsenical residues, but has little effect on lead, and is detrimental to the removal of fluorine. Wetting agents added to the solution have been found very effective in some cases, but not in others. Most are proprietary substances, and should be tested carefully before being put into general use. In the case of oil-sprayed or waxy fruit an odourless kerosene or very light mineral oil added at a rate of 1 gallon per 100 gallons HCl solution heated to 90° F. is satisfactory, but can only be used in flood-type washing machines. Sodium silicate solutions used at concentrations of 60 to 100 lb. sodium silicate to 100 gallons water, when heated to a temperature of from 90° to 120° F., are quite effective in removing lead arsenate plus fish or mineral oil residues, and tend to remove dirt, oil, and wax from the fruit. The solution requires distinct agitation as is obtained in flood-type washers. Sodium silicate is less effective than HCl for apples which have been sprayed with cryolite, calcium arsenate, manganese arsenate, or with lead arsenate plus lime or fungicides containing lime. Soap, kerosene, or preferably a very light mineral oil at a rate of 1 gallon per 100 gallons solution may be added to increase efficiency. A very full description with diagrams is given of flotation-type washers. This type is suitable only for HCl solutions. The flood-type washer, especially when transverse rotary underbrushes are fitted, has been found to be most efficient when either kind of solution is used. The small grower may do the job inexpensively with a dipping tank. In all cases the solution should be discarded after about 1,000 to 1,500 bushels of fruit have been washed. During this process the containers should be cleaned thoroughly to remove accumulated fungus spores, and any spray residues which may have collected in the tanks. Thorough rinsing of the fruit after washing is very important. Fresh water should be changed frequently, but where limited and when the washing solution has been HCl, slaked lime (usually at about 2 lb. per 50 gallons water) may be added to neutralize the acid. The rinsing solution should then be kept alkaline as indicated by using litmus paper which should remain blue. The cost of washing varies greatly with circumstances, but should lie between 1 and 5 cents a box. *Pears* may be treated in a similar manner to apples. Residues are usually lighter. HCl is the most general washing solution, and sodium silicate is unsuitable for russeted varieties, because it darkens the russet areas. Kerosene or other mineral oils should never be added. The flood-type washer is more suitable than the flotation-type because most pears will not float. *Peaches* cannot be washed with HCl, but lead arsenate residues are usually very slight, since spraying is done only when the fruits are very small, and dry-wiping is normally adequate. With *cherries* lead arsenate residues are rarely excessive, and washing in water alone may be sufficient. Sweet cherries have been treated successfully with dilute HCl, but it is thought that the keeping quality of sour cherries would be impaired. *Grapes* and *currants* may carry considerable residues, but have been successfully washed in 0·5 to 1·0% HCl. Proper drying, however, is difficult, and bunches which have been washed should be packed in small containers and shipped at low temperatures.

616. Frear, D. E. H., and Worthley, H. N. 634.11-2.951.23
Study of the removal of spray residues from apples.
J. agric. Res., 1935, **51** : 61-74, bibl. 7.

A number of factors were studied in connexion with the removal of lead and arsenical spray residues. In a comparative trial of two types of washer, the flotation and the underbrush, two apple varieties which had been subjected to treatment with six spray mixtures, three containing lead and three arsenic, were washed in both 1% and 2% HCl at two temperatures in either washer. The results, though variable as might be expected, favoured in both cases the underbrush washer, the difference being significant for lead. Washing solutions were also compared. Sodium silicate, even when heated, did not prove so effective as hydrochloric acid (HCl), and sodium carbonate and soap was found to be of little use. The addition of salt or

nitric acid to HCl solutions likewise proved of little or no advantage. With HCl alone the concentration at which both elements were removed in proportional quantities was about 2% by weight. The higher the concentration the more the residue removed, but the increase was proportionately greater for arsenic than for lead. The addition of a number of commercial wetting agents to HCl under various conditions did not assure an increase in the amount of residue removed. The effect of warming the HCl solution was determined from the trial in which washers had been compared. Washing the apples at 100° F. and at 60° F. showed a definite advantage in favour of the higher temperature for both residues. This applied for both varieties of apple, for both washers, and for HCl at both 1% and 2%. The question of the initial spray mixture was complicated from a number of causes, but certain indications were apparent from the mixtures applied in the test above. The use of a skim-milk spreader made cleaning slightly easier than did other combinations, while the addition of fish-oil caused a residue rather more difficult to remove. Finally the variety of apple was found to be an important factor. The author gives the following list in the order of increasing difficulty in residue removal : Smokehouse, Stayman Winesap, Ben Davis, Grimes Golden, Rome Beauty, Jonathan, Stark, York Imperial, Delicious, Yellow Newtown, and Hubbardston. Of these, however, Ben Davis, Stark, Yellow Newtown, and Hubbardston were only represented by single samples, and some of the others by a limited number, so that the list must be regarded with some caution.

617. Skibbe, A. M. 634.13-2.951.23

The removal of arsenical residues from pears.

Fmg. S. Afr., 1935, **10** : 434-7, bibl. 12.

In South Africa the limit of arsenious oxide residue permitted for fruit to be consumed locally is 0·02 grain per pound, and for export purposes 0·01 grain per pound in conformity with the British tolerance. Difficulties have been experienced by some pear growers in reducing arsenical residues to this standard, and the author undertook an investigation into the matter during last season. The results of his enquiries into current practices are given in this article, together with suggestions for codling moth control and an account of some experiments on the removal of residues. The following recommendations are made :—The use of oil by itself or in mixtures should be avoided for 4-6 weeks before harvest. For early and lightly sprayed varieties receiving the usual spray programme without the addition of oil, dipping in ½% hydrochloric acid (HCl) for 3 minutes or in 1% HCl for 1-2 minutes should be adequate. For late maturing and heavily sprayed varieties the same solution may be used, but the times of dipping should be increased to 5 and 3 minutes respectively. 1% HCl should also prove effective for fruits which have received up to 2-3 oil sprays early in the season, and, where oil has been included with lead arsenate up to within six weeks of picking, 1% HCl for 2 minutes dipping should again be sufficient, but in this case it is advisable to warm the solution to about 90° F. The use of a wetting agent such as lethalate at approximately 0·1% materially increases the efficiency of the acid solution. Pears should not be submerged for a longer period than is necessary to remove visible stains, and emphasis is laid on the desirability of keeping the acid solution at the required strength. If attention is not paid to these details, acid damage at the one end and inadequate treatment at the other are liable to occur. The fruit should be dipped as soon as possible after harvesting to avoid accumulation of wax on the surface, as this makes the removal of residue more difficult. Finally thorough rinsing and drenching with water should be performed, not only to remove traces of acid, but also because this will still further reduce the arsenical content of the fruit.

618. Frear, D. E. H., and Worthley, H. N. 634.11-2.951.23

Removal of spray residues from apples.

Bull. Penn. agric. Exp. Sta., **318**, 1935, pp. 13.

This paper discusses lead arsenate spray residue removal under Pennsylvanian conditions, where mineral oils are rarely included in spray mixtures. Experiments in 1934 showed that the removal of lead presented more difficulties than the removal of arsenic. Recommendations may be summarized as follows :—Fruit should be washed at harvest, not after storing. Underbrush

washers are more efficient, but also more expensive than home-made flotation types. The latter are considered suitable for local conditions, and an account by A. W. Clyde of how one may be constructed is included. Hydrochloric acid at 1-2% by weight used for exposures of normally 1 minute is the most satisfactory washing solution. This should be maintained at the required strength, and changed completely after each 1,000 bushels. The addition of wetting agents seems to be of no advantage, but warming the solution to 100° F. may be of assistance. 2 to 3 gallons of rinse water should be allowed for each bushel of fruit. Drying may be done by the roller or belt type, both of which remove water by means of absorbent cloths, which are wrung out mechanically. Water remains in the stem and calyx ends of the fruit, but this does not matter because packing apples wet does not impair their keeping qualities. The main advantage of drying is that it facilitates grading and packing.

619. Poole, R. F. 634.25 : 632.951.23
Arsenical injury on the peach.
Tech. Bull. N.C. agric. Exp. Sta., **49**, 1935, pp. 13, bibl. 18.
Arsenical injury to peaches in North Carolina and other areas affords a serious problem, because no substitute for arsenate of lead has been found. In this paper the results of previous investigations and of trials and observations extending over a number of years are reviewed. All commercial peach varieties grown in the district are susceptible. Amongst early varieties, Early Rose, Red Bird, Hiley Belle and Georgia Belle suffered severe foliage, bud and twig injury from early spray applications. Defoliation and the production of large cankers and split crocks frequently followed. In the later varieties, Elberta, Hale and Augbert, leaf and shoot injury was less important, but fruit injury was often severe. Immune strains are occasionally found such as one early, light yellow strain of Elberta. On weakened trees fruit injury was most prominent, on vigorous trees leaf, twig and bud injury. There appeared to be little or no correlation between injury and temperature, but humid conditions were directly associated with increased injury. Tests with different limes added to lead arsenate revealed that chemical hydrated limes meshing from two to three hundred were superior to coarse hydrated limes in reducing arsenical injury. Control was not complete when 5 lb. of the former were added to 1 lb. lead arsenate, and further improvements were recorded when lime in excess of this amount was added. The addition of 3-4 lb. zinc sulphate with 5 lb. lime to 1 lb. lead arsenate produced, however, significant control of injury for all varieties, and it is recommended that this should be included in all lead arsenate sprays, and in particular the early applications. Sulphur in various forms may be added successfully to the mixture.

620. Hartzell, A., and Youden, W. J. 632.78
Efficiency of banding for the control of canker worms (*Alsophila pometaria* Harris and *Paleacrita vernata* Peck).
Contrib. Boyce Thompson Inst., 1935, **7** : 365-77, bibl. 5.
A comparison of leaves from banded and unbanded trees showed a difference of less than 10% between the average weights of samples of leaves from treated and untreated trees. The erection of tanglefoot shields demonstrated the fact that the larvae are spread by the wind, which would account for the lack of success achieved by the mere capture of the female adults on the tanglefoot bands.

621. Dotti, F. 632.78
La cattura diretta del baco delle mele. (**Trapping the codling moth (*Cydia pomonella*) by tree banding.**)
Publ. Catt. amb. Agric. Prov. Ravenna, 1934, pp. 26, bibl. 9
and,
Lotta contro il baco delle mele. (**Codling moth control.**)
Reprint from *Romagna agricola e zootecnica*, 1935, Nos. 4-5, pp. 19.
In the first article the whole process of preparing the corrugated paper bands and immersing them in β naphthol oil solution and afterwards of applying the bands to apple trees is described with illustrations of the immersion. In the second article experimental results are described.

β naphthol was found to be more efficacious than α naphthanamine. Very considerable success was achieved by banding with paper impregnated with β naphthol. The chemicals had no deleterious effects on the tree and did not apparently repel the larvae in any way. The advantage of chemically treated banding is that untreated bands have to be changed 5 to 6 times in a season owing to the very rapid pupation and emergence of the insect, whereas treated bands applied in June to the main trunks kill all larvae which take refuge there and can be left till the following January before removing and burning. The author considers that a general application of the practice would quickly result in economy due to the omission of one or more arsenical treatments, and, if persisted in as a normal practice, would in itself reduce codling moth damage to negligible proportions. A short note is added on the application of the method to the control of *Cydia molesta*.

622. Fowler, R. 632.78

Codlin moth control.

Bull. Dep. Agric. S. Aust., **304**, 1935, pp. 106-13.

The most satisfactory lure for use in bait traps has been found to be molasses diluted to 1 in 10. It attracted more moths than either vinegar or fermented apple juice, and was less destructive to beneficial insects such as ladybirds and lacewing flies. 49 traps were used, and the average catch was 41·4 moths per trap. The ratio of females to males trapped, about equal at the beginning of the season, increased to over 2 : 1 towards the end. The use of wire-netting covers as opposed to open wire-mouthed traps more than doubled the catch owing, it is thought, to its preventing the depredations of birds, and should give a more accurate estimation of emergence. 189 bag bandages made from wheat-sacks, examined approximately once a week, caught an average of 12·18 grubs per band, despite the fact that all the trees so treated were receiving a full spray programme. Spraying tests concentrated on a comparison of white oils in combination with lead arsenate, white oils following two arsenate calyx sprays, and oils used alternately with arsenate. The number of applications was five in all cases except one where the last spray was omitted, and in one other case nicotine sulphate was added to the white oil in the last spray. All gave useful control but without significant differences, and the only treatment which might be inferior was that in which the fifth application was omitted. All were economically sound, but in some residue removal might prove more costly than in others. Residues in all cases were above the export tolerance of 0·01 grains As_4O_6 per lb., but those in which white oil figured in the last three applications, especially when used in combination with lead arsenate, were considerably higher than those in which white oil was omitted or used in only one application by itself.

623. Webster, R. L. 632.78

A nine-year study of codling moth trap records.

Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 50-1.

The general use of codling moth traps in the Pacific Northwest is stated to date back to 1926. The number of moths caught daily provides an indication of the rate of emergence and tells the grower when cover sprays may be applied to best advantage. A very brief account is given of trap records and moth activity and damage during the nine years 1926-34. From a study of these seasons the author concludes that infestation in any given year depends primarily upon the initial infestation in the orchard. The factors favouring subsequent larval damage are given as follows :—(1) time of early first brood peaks, (2) egg laying temperatures in May and June, (3) extent of moth activity between broods, (4) start of second brood emergence, (5) moth activity in September. Differences in temperature are largely responsible for seasonal variations in moth activity.

624. Newcomer, E. J. 632.78

Practical methods of orchard sanitation for the control of the codling moth.

Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 66-7.

Despite the use of arsenical sprays up to the practical limits of expense and for residue removal, the codling moth continues to become a more serious problem year by year, and the author urges

the increased employment of supplementary measures of control. The use of bands treated with beta naphthol, following thorough scraping may destroy more than half the larvae leaving the fruit at an average annual cost of less than 10 cents (5d.) a tree. The treatment of field boxes with steam at 170° to 180° F. for 1 minute will destroy the majority of larvae that are in them. The cost in this case is reckoned to be less than ¼ cent per box. A similar result may be achieved by merely stacking the boxes in a screened packing house, which is kept closed until the moths have emerged and died. Sound orchard practice may help further. Adequate pruning and thinning permit the more effective application of sprays. The collection and destruction of wormy fruits at thinning and again at harvest, if done as early as possible, will catch most of the larvae before they have left the fruit.

625. Smith, R. H. 632.78 : 632.944
Possibility of controlling codling moth with nicotine vapour.
Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 72-5.
Preliminary tests with HCN gas to determine its effect on codling moth proved disappointing, but the substitution of nicotine vapour for it has given distinctly encouraging results. The vapour is highly toxic as compared with nicotine dust or spray. A satisfactory portable device for vaporizing the nicotine has been evolved, and likewise tests are being made of a portable fumatorium to enclose a tree at a time.

626. Hough, W. S. 632.78
Results of experiments with non-arsenicals for codling moth control.
Trans. Peninsula hort. Soc. for 1934, 1935, **24** : 12-4.
Two possible substitutes for lead arsenate were tested in Virginia during 1934. Natural cryolite at 4 lb. per 100 gals. in three cover sprays, 1 quart of fish oil being added in two cases, following three lead arsenate applications gave control of codling moth equal to lead arsenate used throughout the season. The use of cryolite with or without oil, when applied in July necessitated washing to remove excessive fluorine residue. 1-1½% hydrochloric acid was more effective in removing this than sodium silicate at 75 lb. per 100 gals. Fixed nicotine in the form of nicotine bentonite did not compare favourably with lead arsenate, but the addition of hydrated lime or bordeaux mixture to the spray tank caused liberation of nicotine, and in this state it proved highly toxic. The author concludes, however, that under local conditions more experimental work will be necessary before a practical schedule for nicotine can be formulated.

627. Marshall, J., and others. 632.78
Increasing and maintaining lead arsenate deposits for codling moth control.
Proc. Wash. St. hort. Ass. for 1934, 1935, **30** : 52-64.
Experiments, in which fish oils were added to lead arsenate to improve the coverage, showed that a slowly drying type with an iodine number of 128 was more effective than a rapidly drying type with a higher iodine number of 181. The addition of 5% oleic acid to herring oil to raise the free fatty acid content of 0·6% improved coverage further. 2 lb. lead arsenate plus one pint herring oil gave results equal to 3 lb. lead arsenate alone, but the substitution of ¼ pint oleic acid for the oil proved inferior. The saponification of ¼ pint oleic acid with triethanolamine raised the effectiveness of oleic acid to about that of the oil. The use of commercial soaps, however, seems to have induced more arsenical injury than fish oil, especially during wet seasons, but there is evidence that a small amount of suitable soap will augment the value of herring oil. The use of kerosene or summer oil with soap (triethanolamine oleate) and lead arsenate also gave satisfactory field results, but the ratio here seems to be of great importance. With soft water and at summer temperatures 0·5% kerosene or summer oil containing approximately 5% oleic acid saponified with triethanolamine oleate, seems to be about the optimum for 3 lb. lead arsenate. Ammonium-caseinate emulsions of either kerosene or summer oil were not so effective in controlling codling

moth as the above. Flocculation of lead arsenate generally seems to be desirable, but the type of flocculation is also of importance, and appears to demand the presence of both an oil and a soap. Saponification of the oleic acid in the summer oil-oleic acid-lead arsenate mixture, though probably advisable, may cause the mixture to break and lead to excessive arsenical injury in some cases. Hence the general use of soaps with oils and lead arsenate cannot as yet be unreservedly recommended.

628 Dotti, F. 632.78
Le irrorazioni arsenicali per la lotta contro il baco delle mele. (**Arsenical sprays to control the codling moth.**)
Publ. Catt. amb. Agric. Prov. Ravenna, 1934, pp. 9.
In this note the author gives particulars of amounts of arsenate of lead necessary, times and numbers of treatments and the atmospheric pressure necessary in the spray pipes. He notes that direct trapping of the larvae by banding may prove an excellent supplementary control measure.

629. Gay, F. J. 634.25 : 632.78
The peach moth (*Cydia molesta* Busck). Investigations in the Goulburn valley, Victoria.
J. Coun. sci. industr. Res. Aust., 1935, **8** : 171-6, bibl. 3.
This progress report for the 1934/5 season describes preliminary work only. Results, however, even in this short period, indicate that the larva rejects all surface tissue and so makes stomach poison sprays of little avail. Contact poisons against the eggs and young larvae offer more hope of success. Nicotine sulphate definitely gave the best results of the contact sprays tested and its compatibility with other sprays makes it very suitable for use combined with early season routine sprays. Considerable success was achieved by banding late in the season towards the end of February, large numbers of overwintering larvae being thus trapped. Untreated bands proved more attractive to the larvae than bands treated with β naphthol. Plain banding also favoured the propagation of the native counter-parasite, *Dibrachys* sp. This parasite is effective only in the winter, and arrangements have now been made to introduce the ichneumon parasite, *Macrocentrus ancyclivorus* Rohw., from the U.S.A.

630. Goidanich, A. 632.78 : 634.25
Il problema della tignola orientale del pesco. (**The oriental peach moth (*Cydia or Laspeyresia molesta*).**)
Ital. agric., 1935, **72** : 374-8.
The author notes the increasing damage done by this pest and the introduction by the Entomological Institute at Bologna of three possible counter parasites, namely *Macrocentrus ancyclivorus* Rohw., *M. delicatus* Cress. and *Glypta rufiscutellaris* Cress. These first two hymenopterous parasites have been reared and multiplied at Bologna and have now been released in one or two fruit centres where they appear to be thriving. It is impossible, however, as yet to say whether the climatic and other environmental conditions will be favourable enough to allow them to do their appointed task of appreciably reducing the numbers and hence damage of the peach moth. The third parasite, *G. rufiscutellaris*, an ichneumon, has only just arrived in Italy. Meantime the following control measures are recommended with a warning that they depend for success on thoroughness and on their universal application :—Collection, say once a week, of infested shoots and later small fruits, this being particularly important during the appearance of the first generations. The spoiled shoots and shoots with larvae still inside are the essential ones to collect, not those yellow and dried up and already deserted by the larvae. This infected material must be destroyed at once. Maggoty, fallen fruits must be removed. Summer and, if possible, winter prunings should be removed and not left on the ground. A useful practice

is to band the trees with corrugated cardboard from time to time. The insects will pupate therein and are removed by periodically changing the band. A further useful device is to trap the moths by the suspension of molasses or other bait in 1 to 2 litre receptacles hanging from the trees.

631. DAVIDSON, J. 632.73 : 634.11
The apple thrips (*Thrips imaginis* Bagnall).
J. Coun. sci. industr. Res. Aust., 1935, **8** : 233-6.
The article summarizes the essential existing information on the subject of thrips control. The work so far has centred on insecticides which might be used to protect apple blossom, berry fruits and other flowers during the critical period of their infestation by thrips and has so far been restricted to laboratory or small field tests. It is hoped to carry out extended field trials next spring. The following suggestions are put forward as a basis of operations :—(*a*) *Treatment of unopened buds.* Spraying or dusting as for open blossoms (*b*) may be used. It is possible that a finely-ground substance like kaolin applied as a wet spray with spreader added may form a mechanical barrier over the openings into the buds and so prevent the entrance of thrips. (*b*) *Treatment of open buds.* The aim is to drive the thrips out of the open blossom and keep them out on critical, hot days. Dusts are convenient and the following formula has given promising results with small tests :—Kaolin or talc 80% or 70%, derris (fine-ground) 15% or 20%, pyrethrum (fine-ground) 5% or 10%. The dust should be effective for about 2 days, after which treatment must be repeated. Little success has yet been achieved with sprays.

632. ANON. 632.69
A new rabbit repellent.
Ill. Hort., 1935, **24** : 3-4.
A very successful rabbit repellent, harmless to the trees and easy to prepare, is in use at the Michigan Experiment Station, U.S.A. It consists of five parts resin and one part linseed oil melted together.

633. MUNGOMERY, R. W. 632.961
The Giant American toad (*Bufo marinus*).
Qd. agric. J., 1935, **44** : 242-8.
An account is given of the valuable work of the Giant American toad in controlling insect pests, notably various kinds of sugar cane beetle, in the tropical countries into which it has been introduced. The suggestion is made that if established in the cane lands of Queensland it might act as a useful check on the grey back sugar cane beetle and other insect pests which spend a part of their time on or near the ground.

634. ANON. 634.1/7 : 628.54
A waste fruit pit.
Agric. Gaz. N.S.W., 1935, **46** : 522.
This is a description of an insect proof pit for the reception of waste and fruit fly infested fruit. Its purpose is to avoid the difficulties associated with destruction by burning or boiling. The usual dimensions of the pit are 6 ft. in length, breadth and depth. This size will hold about 150 bushels of fruit. The most useful cover is made of hardwood framework covered with galvanized iron and having a central hatch through which the fruit is dumped. In one corner is a wire netting covered glass window which serves to draw the flies away from the central opening. Soil is banked round the edges of the cover.

The following also is noted :—

MALENOTTI, E. Terzo contributo alla lotta contro i nemici del melo. **(A third note on the control of apple pests.)**
Ital. agric., 1935, **72** : 217-37.

VEGETABLE GROWING.

635. BLAIR, W. S. 635.1/7
The vegetable garden.
Pamphl. Canad. Dep. Agric. **166**, 1935, pp. 18.
The author urges farmers and others to establish vegetable gardens which will supply household requirements, and to this end provides short notes on general principles of cultivation and on a very large number of market garden crops.

636. BARTON, L. V. 635.1/7 : 631.531
Storage of vegetable seeds.
Contrib. Boyce Thompson Inst., 1935, **7** : 323-32, bibl. 23.
The seeds of most of the following plants were submitted to open and sealed storage, at room temperature and at — 5° C. (23° F.), both in their normal state and after being treated in various ways to remove water :—carrot, cauliflower, eggplant, lettuce, onion, pepper and tomato. Germination and seedling production tests were made on fresh seeds and after 1, 2 and 3 years of storage. Eggplant and tomato seeds kept well under all conditions. Carrot, lettuce, onion and pepper seeds were injured by sealed storage at room temperature unless dried previously. Dried, sealed storage was superior to open storage at room temperature. Lettuce seed showed increased power of seedling production with increased time in dry storage. Results indicate that under Yonkers (New York) conditions most of the seeds tested retain their vitality for two years under open storage at room temperature and humidity. By the use of cold storage, or by reducing moisture content of seeds to 6% and using sealed containers at room temperature, vitality is assured for at least 3 years.

637. HILL, H. 631.8
Some fundamentals of nutrition of horticultural crop plants.
Sci. Agric., 1935, **16** : 21-5, bibl. 12.
This paper consists of a brief outline of the present knowledge of plant nutrition and the means by which plant food requirements may be diagnosed. The principal method is by the appearance of the plant, certain symptoms indicating certain deficiencies or disturbances of food balance. These diagnoses can be checked by micro-chemical tests on the plant tissue, and so reduce the danger of confusion of deficiency symptoms with changes of appearance brought about by environment. The article concludes with a summary of foliage characteristics and chemical data indicating nutritional disturbances as noted at the Central Experimental Farm, Ottawa. *Nitrogen.* Assuming soil and moisture conditions to be favourable, nitrogen starvation is indicated by a pale-green or yellow-green foliage accompanied by slow growth. The foliage as in apples may develop reddish tints in autumn. Excess of nitrogen is shown in general by very dark green, even purplish foliage, often with marginal scorching. The particular symptoms which develop in chrysanthemums and tomatoes from overfeeding with nitrogen are described. There is a strong correlation between nitrogen excess and blossom-end rot of tomatoes. *Potassium.* Deficiency is shown by a yellowing of the leaf margins followed by scorching. It resembles injury from nitrogen excess and is a symptom of a wide potassium-nitrogen ratio. Large excesses of potassium have been observed to have little outward effect on chrysanthemums and tomatoes, other than the production of a somewhat lighter green foliage and in chrysanthemums of a slight yellow mottling. *Phosphorus.* Deficiency is signalized by a stunting of growth, with small sized leaves dull green or greenish-brown, later turning to purple or blueish purple. In apple foliage a brownish bronze cast remains. The opening of leaf and blossom is delayed. Excess of phosphorus (in sand cultures) has resulted in reduced bud formation, vigour and growth in chrysanthemums. In tomatoes a yellowing of the leaf margins occurred followed by fairly large white necrotic areas. *Calcium and magnesium.* In apples each deficiency produced dead brown patches on the margins and centres (edge and centre blotch). Calcium deficiency gave very long leaves. In tomatoes magnesium deficiency gave a distinctive white scorching of the leaves, with a dark brown or black line between the white area and the part which was still green. The injury worked inwards from the edge. Circular areas

like watermarks occurred within the affected tissue. *Chemical data.* At Ottawa analyses of plants produced under controlled supplies of nutrients in sand cultures showed in strawberries a marked reduction in total carbohydrates which appeared in reducing sugars, sucrose and starch, and an increased nitrogen accumulation following the withdrawal of potassium. Analysis also showed that as calcium rose the potassium content fell and *vice versa.* A similar negative correlation was found between potassium and phosphorus.

638. CAROLUS, R. L. 635.1/7 : 631.454
Magnesium deficiency in vegetable crops.
Trans. Peninsula hort. Soc., 1934, **24** : 81-7.

The causes of magnesium deficiency in the soils of the Atlantic Coastal States from Maine to Florida are attributed to a natural dearth of magnesium bearing rock, heavy rainfall combined with mild temperature allowing of continuous leaching, and continuous cropping combined with the application of fertilizers which contained no magnesium and owing to their residual acidity caused the solubility and leaching of magnesia. On an acid soil a crop of sorghum, to which nitrogen had just been added, when ploughed under decomposed very rapidly, liberating a large quantity of magnesia which was readily utilized by the succeeding potato crop. A table showing the detrimental effect of soil acidity on yield of potatoes is given. Although at pH 4·4 the plants absorbed more magnesia than at pH 5·0, magnesium deficiency was more pronounced at the lower reaction, because owing to the low calcium content (2·79%) part of the magnesium absorbed at pH 4·4 had to function as an aid to the calcium in the plant. When, as at pH 5·0, the calcium content of a plant was sufficient, magnesium deficiency trouble was reduced. The increase of yield resulting from the addition of magnesium to a light soil is shown in pounds per acre for 16 crops. This ranged from 1% in onions to 92% in turnip roots. Onions, corn and carrot do very well on magnesium deficient soils. A brief description of the symptoms of injury due to magnesium deficiency is given for the leaves of these 16 crops. Magnesium deficiency can be remedied on light soils by the application of a slowly available limestone, while on heavier soil types soluble magnesium salts can be used without danger of their being leached. A final table shows the magnesia requirements of 15 vegetable crops and the amount lost when the crop is removed from the field.

639. GILBERT, B. E. 631.811.9 : 635.1/7
Normal crops and the supply of available soil manganese.
Bull. R.I. agric. Exp. Sta., **246**, 1934, pp. 15, bibl. 12.

Data collected over a number of years at Rhode Island, and correlated with results found elsewhere, indicate that the appearance of manganese chlorosis in field crops and vegetables may be associated with several factors. Lack of available soil manganese has been proved to occur in certain alkaline soils or where lime applications have been sufficiently heavy to fix the manganese in unavailable form. Plant susceptibilities are rated as follows:—High sensitivity: spinach, beets, oats; medium: sweet corn, lettuce, onions, mangels, grasses; low: potatoes and beans. Climatic conditions also appear to play a part. At Rhode Island spring spinach crops have showed chlorosis, whereas autumn crops following in the same year have sometimes been normal. The suggestion is put forward that a slower growth rate as caused by lower temperatures may enable the plants to withstand deficiency better. Experiments in correcting chlorosis have shown more efficacious results from applications of manganous sulphate than of potassium permanganate. The former applied as a spray at 8 lb. per acre has produced marked increases in spinach yields, and soil applications at 30 lb. per acre have achieved similar results, but there is evidence that spraying is the more efficient, once the symptoms of chlorosis have appeared. Manganese deficiency has been recorded mainly in soils with a reaction of pH 7 or over. Liming in such cases should be unnecessary and should be avoided, and fertilizers, which tend to increase acidity, such as sulphate of ammonia, should be used in preference to neutral or alkaline forms, because there are indications that fixed manganese is liberated as the soil becomes progressively more acid. The use of farmyard manure and other refuse also appears in some cases to have prevented the disease from developing. Finally, a note is added on tests

conducted with normal and chlorotic spinach plants to determine whether a chlorotic condition and low manganese content were associated in any way with vitamin A. The results indicate that there is no such connexion, and in the light of present conceptions there seems to be no reason to expect a relationship between chlorophyll content and vitamin A.

640. HARDENBURG, E. V. 633.491

Greensprouting seed potatoes.

Bull. Cornell agric. Exp. Sta., **632**, 1935, pp. 29, bibl. **11**.

The results of a four-year study of greensprouting seed potatoes in New York State have indicated that the practice has the following effects :—Increases have been noted in stolon number and stolon weight, and generally in the number of tubers per stem, whilst significant increases have been found in the yields per acre of marketable-size tubers. Greensprouting does not, however, increase the stand of plants, and, although it promotes earlier emergence, this superiority in top growth with later varieties is not necessarily maintained as the season progresses. Two weeks seems to be a suitable period for greening. Lengthening this time may increase yields, but not sufficiently to justify the extra risk and expenses. Planting depths of 2″, 4″, and 6″ were also tested over the four-year period. Planting at 4″ gave the highest average yield of number 1 size potatoes, but this was not significantly higher than the average yield from potatoes planted at 2″. Shallow planting gave a significantly larger number of stems per plant, but there was no appreciable difference between the 4″ and deeper plantings. The number of tubers from plantings deeper than 4″ was, however, invariably lower. The most suitable depth is therefore taken to lie between 2″ and 4″.

641. BEAUMONT, A. B., AND OTHERS. 635.25

Onions in the Connecticut Valley.

Bull. Mass. agric. Exp. Sta., **318**, 1935, pp. 31, bibl. in text.

Onion cultivation in the Connecticut Valley has been subjected to a comprehensive range of experiments, the results of which are given in this paper. Five crops were grown from seed and three from sets. The soil had an initial pH value of 5·3, and marked increases in yield were obtained from 2 applications of ground limestone, each of 1 ton, this increase being maintained in the year following liming. The optimum reaction is considered to lie between pH 6·0 and 6·5. In experiments with fertilizers the greatest response was obtained from the use of phosphates, but significant increases were only obtained when potash was also added in sufficient quantity. Nitrogen was only effective when applied later in the growing season as a side dressing, and then only with onions grown from seed, not with those from sets. For local conditions a mixture of 4-12-8 is recommended, the rate of application giving the best results in these experiments being 2,500 lb. per acre. For onions grown from seed the use of organic nitrogen for one-half of the above mixture gave better results than the use of inorganic nitrogen alone. In the case of onions grown from sets the difference was negligible, apparently largely because of the shorter growing season. Muriate of potash gave as satisfactory results as sulphate, and double-strength mixtures (8-16-8) as standard single strength 4-8-4. Experiments with cover crops appear to have been rather inconclusive, but it is believed that they may prove more successful with set than with seed onions, because the former mature and are removed earlier. The results of experiments in spacing and rate of seeding indicate that the rather common local practice of using 4-5 lb. seed per acre in rows 13″ apart is a suitable, if not the best, system. The best size for sets appears to be ½″ to ¾″ in diameter. Larger yields were obtained from sets ¾″ to 1″ in diameter, but owing to the higher percentage of seed stalks produced the resulting crop was of poor quality. Where large sets are used, the removal of seed heads by snapping them off as they appear is recommended. Sets smaller than ½″ do not give good results. Selection and breeding work has so far failed to produce any strains of commercial importance, but the practice, used in this work, of transplanting to the field young onions started in the greenhouse, is thought to have possibilities as a practical cultural method. The control of thrips has been successfully obtained over a number of years by the use of a nicotine-soap spray. At the height of the growing season a second application should follow only 5 or 6 days after

the first because of the rapidity of reinfestation. Set onions are a favourite breeding place for thrips, but seed onions if grown at some distance away are much less subject to severe attacks. Types of onions with upright growth and an open chit are more resistant to attack than those not showing these characteristics.

642. MAGRUDER, R., AND HAWTHORN, L. R. 635.25 : 632.111
Effects of freezing and cold weather on immature onions.
Circ. U.S. Dep. Agric., **355**, 1935, pp. 11, bibl. in text.

The coincidence by which some fifty-five strains representing 20 varieties of onions happened to be growing at Winter Haven, Texas, during an unusually severe spell of cold weather during February provided the basis for the comparison of varietal susceptibilities set forth in this paper. The weather in January had been warm and conducive to rapid growth, but in the middle of February a period of cold conditions showing minimum temperature on five successive days of 18°, 21°, 34°, 26°, and 32° F. occurred with very deleterious effects to many crops. Subsequent weather again favoured rapid growth. In addition to the only two varieties grown commercially in the locality, Yellow Bermuda and Crystal Wax, the following onion varieties showed marked susceptibility to injury :—California Early Red, Italian Red, Extra Early Yellow, Prizetaker, and Sweet Spanish types, all being relatively recent introductions from Southern Europe. Local domestic varieties showed a lower percentage of plants killed. Differences were also observed between strains of certain varieties, which appears to indicate that the resistance to freezing is partially inherent and should therefore be considered in onion breeding and selection. The tendency toward " doubling ", i.e. producing two or more smaller bulbs in place of one was more marked on the whole in the flatter than in the round or globe varieties, and was most prevalent in the variety Crystal Wax. Different behaviours in relation to strain were again noted. The term " multiplier " was applied to plants in which from 4 to 15 small shoots developed from the single stem plate or root plate. Such plants are worthless, but only Yellow Bermuda and Italian Red produced appreciable numbers. Seed stalks were even less in evidence, most types producing none, whilst the highest figure was only 1·6% for Crystal Wax.

643. RAWES, A. N. 635.31
Some experiments in asparagus cultivation.
J. roy. Hort. Soc., 1935, **60** : 452-3.

Three comparisons are made in asparagus experiments begun at Wisley in 1931. (1) *Male v. female plants.* The number of saleable stems gathered over three seasons from 10 beds, each holding 64 plants spaced 2′ × 3′, half of the beds containing male and the other half female plants, showed an advantage of approximately 60% in favour of the male plants. The actual figures were 14,274 to 8,838 stems. The variety was Connovers Colossal. (2) *Male v. female plants.* The proportions of stems based on size, large, medium, and small were practically the same for both sexes. (3) *Close v. wide planting.* Figures based on three years' cropping are given, but it is considered to be too early as yet to express a definite opinion upon the optimum spacing. The variety in this case was Harwood's Giant.

644. WALKER, J. C., AND LARSON, R. H. 635.34 : 632.42
Calcium cyanamide in relation to control of clubroot of cabbage.
J. agric. Res., 1935, **51** : 183-9, bibl. in text.

In previous experiments* it was shown that in well-watered soil in a greenhouse the infection of cabbage by the clubroot organism, *Plasmodiophora brassicae* Wor., was appreciably reduced when the soil reaction was raised to about pH 7·0, and that at pH 7·2 and above infection was usually inhibited. The increase in alkalinity was brought about by applications of calcium hydrate ($Ca(OH)_2$) and calcium carbonate ($CaCo_3$). In the field, however, even heavier applications frequently failed to provide control. In the present paper the effect of calcium

* Larson, R. H. and Walker, J. C. Soil treatment in relation to clubroot of cabbage. *Ibid.*, 1934, 48 : 749-59, *H.A.*, 1934, 4 : 3 : 403.

cyanamide ($CaCN_2$) was compared to that of $Ca(OH)_2$. The greenhouse soil used in this test had an initial reaction of pH 6·4. Control of clubroot was obtained by adding $CaCN_2$ at a rate of 250 lb. per acre and was similar to that obtained by the use of 525 lb. $Ca(OH)_2$. When $CaCN_2$ is applied to moist soils, it undergoes hydrolysis to $Ca(OH)_2$ and urea, $CO(NH_2)_2$. These two components when applied together in place of $CaCN_2$ produced some measure of control, but not such complete control as did $CaCN_2$ itself. It is therefore concluded that the effect of $CaCN_2$ is partly due to the CN_2 anion operating before hydrolysis takes place. A description follows of three field trials, in which various amounts of $Ca(OH)_2$ and $CaCN_2$ were applied to different plots. The natural soil reaction was similar to that of the greenhouse soil except in certain plots, which had received dressings of hydrated lime some three years earlier, and which in consequence tended to have a rather higher pH value. The results over two successive years confirm that, as in the greenhouse experiment, $CaCN_2$ is, weight for weight, about twice as effective as $Ca(OH)_2$, but as in earlier trials* control was not so complete in the field as in the greenhouse. Satisfactory results were, however, obtained when $CaCN_2$ was added at a rate of 400-800 lb. per acre to soil, which had been limed some 3 or 4 years earlier. The authors therefore regard calcium cyanamide as having some value, and suggest that, where soil acidity needs correction in order to reduce clubroot infection, $CaCN_2$ should be added up to the point where nitrogen requirements of the crop are satisfied, and that if any further neutralizing agent is then necessary it should be supplied by using $Ca(OH)_2$.

645. BROWN, W. 635.52 : 632.482

On the botrytis disease of lettuce, with special reference to its control.

J. Pomol., 1935, **13** : 247-59.

Previous work by Abdel-Salam, *Ibidem*, 1934, 12 : 15-35, *H.A.*, 1934, 4 : 1 : 88, and by Helali had indicated that manurial treatment was unlikely to effect any significant control of the disease, but that immersing lettuce seedlings in a weak (approximately 0·5%) solution of Uspulun or better Nu-green (= Uspulun + an ammonium salt) effected appreciable control, i.e. survivors varied from 50% to 60%. Increasing the concentration increased the control but resulted in damage to the plants. The present author confirmed these results on control and found the use of mercuric chloride (1 : 1,000) had much the same results both as regards control and damage done. Much better results without the same danger of plant damage were achieved by the use of the non-mercurial dust " Brassisan ", the effective constituent of which is a chloronitrobenzene preparation. Experiments indicated that so long as the roots were reasonably protected from contact with the dust, this could be used with perfect safety on lettuce. A large number of tests were made with the variety Trocadero and these are described here. With regard to possible damage the only case of severe damage occurred when the roots themselves were liberally coated with dust. No check to growth or other injury was noted when seedlings were dusted *in situ* a few hours before being pulled up and sent out, heaped in a box, to the field, whereby the roots ran some risk of coming into contact with the dust. A slight check has sometimes been seen when seedlings are dusted in frames or in the greenhouse. The form taken is a slight mottling and puckering of the leaves on which dust is laid and a delay in development of the younger leaves, which gives the appearance of dwarfing. This effect disappears within a few weeks. There is little information yet as to the minimum effective dose or the number of profitable applications. Two treatments would appear to be beneficial. Application is either by traversing the frames by the blower or by merely blowing the dust into the frames.

646. WALKER, M. N. 632.48 : 635.61

Commercial control of watermelon anthracnose.

Press Bull. Fla. agric. Exp. Sta., **471**, 1935, pp. 2.

Anthracnose is the most important watermelon disease throughout the greater part of Florida. Infection starts with spores left on the seed during the previous harvest. The disease develops with germination, but does not usually become conspicuous in the field until some reinfection

* Larson, R. H. and Walker, J. C. Soil treatment in relation to clubroot of cabbage. *Ibid.*, 1934, 48 : 749-59, *H.A.*, 1934, 4 : 3 : 403.

with new spores has occurred. These spores are spread almost entirely by water, and as such may often be carried by persons walking through the fields when the plants are wet, and particularly when the leaves are brushed aside with sticks to determine which melons should be removed in thinning and during picking. Once the disease is widely distributed and firmly established, control measures become of little economic use. Preventive measures are therefore important. All seed should be soaked before planting in a 1 in 1,000 bichloride of mercury solution for 5 to 10 minutes, afterwards being thoroughly rinsed in water and dried in a shady place. There is also evidence that dusting with organic mercury compounds may be equally effective. Subsequently the young plants should be treated with two or three applications of a 20-80 copper-lime dust or a 4-4-50 bordeaux spray, the first application to be made just as the plants begin to form vines and thereafter at intervals of about 10 days. The object is to keep a uniform fungicidal covering on the plants throughout the period when primary infection centres are formed. Second in importance to seed treatment, however, is the prevention of workmen walking through the vines in wet weather. Where these precautions are taken, anthracnose is unlikely to become serious, but, if it does, a dusting to prevent lesions on the melons may be advisable.

647. SEATON, H. L. 635.63

The influence of the length of the interval between pickings on the yield and grade of pickling cucumbers.

Spec. Bull. Mich. agric. Exp. Sta., **259**, 1935, pp. 20.

A large field area in Michigan is devoted annually to the growing of pickling cucumbers, and for this purpose it is the small fruits which are the most valuable. The experiments described here were repeated over three years to determine the interval between pickings, which would produce the most profitable returns. The fruits picked were graded into (1) *Small*, all straight, perfectly shaped cucumbers less than $3\frac{1}{4}''$ long and $1\frac{1}{8}''$ in diameter. (2) *Large*, as above, but more than $3\frac{1}{4}''$ and less than $5\frac{1}{2}''$ long and more than $1\frac{1}{8}''$ but less than $2''$ in diameter. (3) *Nubbins* and *Crooks*, mis-shaped fruits of all sizes. (4) *Culls*, over-matured fruits and large, seedy nubbins which would be rejected at salting stations. Picking intervals were 1, 2, 3 and 4 days in all three years, but in the second some additional plots were also picked over at 7-day intervals. All plots were replicated several times, and other treatments were the same in all cases. The more frequently picking was done, the larger the number of fruits produced, but the smaller the total weights. When analysed on a basis of grades it was found that the percentage of small fruits increased and of large fruits decreased with more frequent pickings. The percentage of nubbins and crooks remained more or less constant for all the intervals, but the percentage of culls was increased where the interval was lengthened beyond 4 days. For purposes of financial returns small fruits were valued at $1.25 per cwt., large at $0.75 per cwt. and nubbins and crooks at $0.50 per cwt. On this basis the total gross returns for the three years were not very markedly dissimilar for the 1, 2, 3 and 4 day intervals, but when the estimated harvesting costs were deducted a considerable loss was shown by the 1-day interval; the 2-day interval just covered expenses; but both the 3- and 4-day intervals showed reasonable profits, the latter being somewhat the larger. The suggestion is made that under ordinary soil and weather conditions cucumber fields should be picked over twice weekly.

648. YU, T. F. 635.63 : 632.4

Pythium damping off of cucumber. [English-Chinese summary.]

Agric. sinica, 1934, **1** : 91-106, bibl. 29.

A *Pythium* damping off disease very prevalent and destructive to cucumber seedlings in Nanking is described. The causal organism is identical with that of *P. aphanidermatum* (Eds) Fitz. Of the disinfectants tried acetic acid (1·5 and 2% solutions) applied at the rate of 2 quarts per sq. ft. of soil completely eliminated the damping off and caused no injury to seeds when these were sown 9-13 days after treatment. The fungicidal value of the disinfectant was greatly reduced, if the soil was too wet. Formaldehyde (40%) diluted to 1 : 40 and 1 : 50 was also 100% effective, but a dilution of 1 : 60 failed to effect complete control.

649. SMITH, O., AND COCHRAN, H. L. 635.64 : 581.162.3
Effect of temperature on pollen germination and tube growth in the tomato.
Mem. Cornell agric. Exp. Sta., **175**, 1935, pp. 11, bibl. 7.
The maximum germination of pollen in these experiments was 66% after 60 hours at a temperature of 85° F. 70° F. gave nearly as good results, but at 50° F. only 21·5% germinated after 60 hours and at 100° F. only 6·3% after 42 hours. The time taken to germinate was also on the whole distinctly shorter at 70° or 85° F. than at 100° F. Studies on the rate of pollen tube growth revealed a similar response to temperature, but in this case 70° F. produced more rapid development than did 85° F. 50° F. was inferior, and at 100° F. the growth rate, never at best very rapid, became so slow as to make it unlikely that fertilization could occur before the embryo-sac contents disintegrated.

650. SMITH, K. M. 635.64 : 632.8
New virus diseases of the tomato.
J. roy. hort. Soc., 1935, **60** : 448-51.
No fewer than three new virus diseases of the tomato have been identified this year at Cambridge from specimens sent in from different parts of the British Isles. The symptoms of the three diseases are described, but as yet no specific treatments can be recommended. The author puts forward the suggestion, however, that two of these viruses, which are of the tobacco mosaic type, were very probably imported into the country in smoking tobaccos. He therefore advises that men should not smoke while tending tomato plants, and if they are smokers should wash their hands before starting work. The removal of any young plants showing suspicious mottling, and the destruction of insects by fumigation are also advocated.

651. KADOW, K. J., AND SHROPSHIRE, L. H. 635.64 : 632.4 + 632.7
Tomato diseases and insect pests. Identification and control.
Circ. Ill. agric. Exp. Sta. **428**, 1935, pp. 36.
The tomato now ranks second in value as a truck and garden crop in Illinois. The object of this paper is to assist growers to identify and control its more important diseases and insect pests. At the outset certain general recommendations are made for the prevention of infections. The use of disease-free seed is the first consideration. This may be ensured by saving seed from plants known to be healthy, or, if the origin is uncertain, seed should be soaked for 5 minutes in a solution of corrosive sublimate, 1 part in 3,000 parts water, and then rinsed in running water and dried. Soil which has not grown tomatoes or related plants before is to be preferred, but if it is not known to be disease-free, thorough sterilization is advisable, or alternatively, if this is not done, the seeds should be dusted with red copper oxide or copper carbonate. In crop rotations tomatoes should not be grown on the same land more often than once every three years. Field sanitation is important at all times. Weeds should be eradicated as potential harbours for insect pests, and debris left after harvest is better destroyed than ploughed in. Where workers have been using tobacco in any form, or have been handling other plants, they should wash their hands thoroughly in soap and water before touching tomato seedlings. The more important diseases in Illinois appear to be mosaic, bacterial canker, *Fusarium* wilt, *Septoria* leaf spot, bacterial rot, damping off, and leaf mold in greenhouses. The physiological disease blossom-end rot may frequently be a prelude to infection by other organisms. Diseases of lesser significance are streak, verticillium wilt, collar rot, and the physiological disease known as hollow stem. The insects causing injury to tomato plants are flea beetles, whiteflies, eelworms, and symphylids. A description of the disease or insect is given in each case and appropriate control measures are recounted. Finally, sections are devoted to methods of soil sterilization and to fungicides and insecticides. The most efficient method of sterilizing the soil in glass-houses is by steaming with tile lines, using 4-inch tiles in lines 24″ apart and about 15″ deep. The steam pressure should be 15 to 25 lb., and the process may be considered complete when a medium-sized potato, placed between two lines at about 3″ below the surface, is well cooked. An essentially similar method is the use of 1½″ to 2″ pipes, bored with $\frac{3}{16}$″ holes at intervals of 1 foot. The pan method of applying steam is especially suited to the sterilizing of soil in benches

or flats. For small areas boiling water may often prove practical and efficient, and finally, where none of the above methods can be applied, formaldehyde, 1 lb. commercial in 20 gals. water, may be used at a rate of about 1½ gals. per square foot. This chemical treatment is, however, generally rather expensive, and will not control nematodes. Moreover, seeds or plants must not be placed in the soil for 10 to 14 days after treatment. For fungicides and insecticides the following formulae are given :—Bordeaux mixture 4.4.50 ; bordeaux dust with stomach poison, the formula being 16 lb. monohydrated copper sulphate, 64 lb. hydrated lime, 20 lb. arsenate of lead ; nicotine dust, formula 3 lb. 40% nicotine sulphate poured over and mixed with 47 lb. hydrated lime ; poison bran bait, formula bran 25 lb., molasses 2 quarts, water 10 quarts, paris green 1 lb. ; and lastly, a new oil bait which shows promise, formula bran 25 lb., medium heavy lubricating oil 2 quarts, paris green 1 lb.

652. CLAY, S. 635.656

Notes on the inheritance of quantitative characters in a cross between two varieties of garden pea (*Pisum sativum* L.).

J. Pomol., 1935, **13** : 149-89, bibl. 27.

Plant breeding rather than genetical investigation has been the primary aim of the work recorded here on the progeny in successive generations of Little Marvel crossed in both directions with a form known as " FB ". Results in the F_2 and partial later generations are compared with those obtained by other investigators working with peas and practical difficulties are discussed. The following notes are taken from the author's summary. *Pod breadth.* A mainly simple relationship is found to hold, modified by minor genes, or possibly by factorial interrelationships in some cases. *Seed size and shape.* These are probably dependent on a single pair of allelomorphs. Size is difficult to work with owing to great susceptibility to environmental influences. *Percentage of 2-flowered-racemes.* This is subject to abnormally high fluctuation, but a general tendency exists for a high percentage to dominate over a low one. *Period.* The period needed for pod development was not susceptible of analysis. *Foliage colour.* A slight difference in depth of green behaves as if determined by a single allelomorphic pair of genes. *Correlation of characters.* Narrow pod, small seed. Little Marvel shaped seed, numerous 2-flowered racemes, early flowering, rapid pod development and short stem to the first fertile node are shown to be associated to a varying degree in the hybrids. In other words, all the examined characters, except foliage colour, tend to remain associated together in the parental combination.

653. WARE, W. M. 635.8

Mushroom-growing.

Bull. Minist. Agric. Lond., **34**, 1934,* pp. 28, bibl. 55.

The second edition of this bulletin is now reprinted with amendments. As a guide to the cultivation of mushrooms indoors, out-of-doors, or in pastures, and to the picking and packing and diseases and pests of the crop it should prove of great value. The only section subjected to considerable revision is that dealing with pest control. Small flies, some of which are harmful, are apt to infest heaps of manure in process of preparation. It is suggested, therefore, that the site chosen for composting should be at some distance from old manure heaps, and that it should be as clean in other respects as possible. Moreover, the breaking up of large lumps and turning, if properly done, should ensure even heating to temperatures which will destroy the eggs or larvae of flies. Subsequently in houses the heat of newly made beds will either kill these insects, or drive them to the surface, where they can be dealt with by fumigation. Flowers of sulphur at not more than 1½ to 2 lb. per 1,000 cu. ft. is recommended for use before, but not after, the beds are spawned. It is burnt on metal trays, the house being kept closed for 5-6 hours. Where beds are all on the floor, dusting with nicotine would probably be more effective than sulphur. As a general precautionary measure doorways and ventilators should be provided with fine-gauze screens. In addition to other slight alterations in the text the bibliographies on cultivation and on pests and diseases have both been augmented since the first edition.

* First edition 1931 ; Second edition 1932, reprinted with amendments 1934.

654. AUSTIN, M. D., AND JARY, S. G. 635.8 : 632.6/7
Investigations of the insect and allied pests of cultivated mushrooms, IV and V.*
J.S.E. agric. Coll., Wye, 1935, No. **36**, pp. 103-10, bibl. 3.

In 1934 *Sciara fenestralis* occurred regularly in the manure heap used for the preparation of mushroom beds, the larvae being found alive at temperatures of 158° F. and 162° F. It is thought that infestation of beds may therefore occur by the introduction of flies or their larvae in the compost. The only other pest found in any numbers was the springtail, *Hypogastrura armata*. Nicotine sprays at a strength of 1 : 1,600 did not kill the eggs of *S. fenestralis*. The larvae were under very favourable experimental conditions killed by nicotine spraying to the extent of 60%, but it is thought that under commercial conditions even this degree of control would be unattainable. In mushroom houses such sprays are only effective against adult flies and spraying should therefore be done frequently as a matter of routine. Common salt solution at 1 : 160 was not toxic to *S. fenestralis* larvae. Tyroglyphid mite injury was checked by spraying a proprietary oil emulsion on growing mushrooms without damage to the mushrooms, the temperature of the liquid being 104° F.

The following also is noted :—

MACK, W. B., AND OTHERS.
Vegetable variety and strain trials. *Bull. Pa. agric. Exp. Sta.* **313**, 1935, pp. 36.

FLOWER GROWING.

655. WYMAN, D. 635.9
Research in ornamental horticulture in the United States.
Commun. II ème Congr. Int. Hort. (Rome), 1935, pp. 9.

General lines of practical investigation in ornamental horticulture by Research Stations in U.S.A. are outlined. *Tree manuring.* The problem of artificial manures for ornamental shade trees is complicated by the fact that many trees are standing on lawns which might be seriously injured by a broadcast fertilizer. Early applications in spring do less injury to the grass than later ones, or the manure may be inserted in holes in the ground under the branch spread. Excellent results have been obtained at Cornell with ammonium sulphate and more particularly with ammophos applied at the rate of ½-1 lb. per inch caliper of trunk. It has been found that the addition of phosphorus to nitrogen greatly increased tree growth. *Rooting media studies.* Extensive work has been done on the relative merits of various rooting media for cuttings. As a result a large number of woody plants have been classified as rooting best in sand or peat moss, or a mixture of both. Whatever the medium results in many cases seem to have been considerably aided by the application of a solution of 1 lb. potassium permanganate to 15 gallons of water distributed at the rate of 2 quarts per sq. ft. *Exact place for making the cut in cuttings.* Experiments made with soft-wood cuttings enabled the best position for the cut in relation to the node to be decided for a large number of plants. Results with evergreen cuttings were the same when a piece of the previous year's wood was attached as when the current season's growth only was used. Evergreen cuttings set in frames outside rooted best when taken in August, and in a greenhouse from October to February. *Thuja occidentalis* varieties also root well if taken in March and April. *Electric hotbeds.* Many soft-wood cuttings in summer rooted better with the even temperature of an electric hot bed than in a manure hot bed. Over a period of years the electric hot bed cost considerably less to install and run than it did to make up a manure hot bed each year. *Seed germination.* At the Boyce Thompson Institute Dr. W. Crocker has, by stratifying a series of seeds of ornamental woody plants at different temperatures, been able to break their dormancies so as to obtain germination in one year of seeds that normally require two. *Waxes and oils on evergreens.* Experiments are in progress, but not yet sufficiently advanced, to discover a coating for foliage of evergreens in course of transplantation which will

* See *Ibid.*, No. 32, p. 59, and No. 34, p. 70, *H.A.*, 1933 : 3 : 3 : 361, 1934, 4 : 3 : 416.

prevent transpiration and so do away with the need of digging them with a ball of soil. Vegetable oil emulsions seem to be the most practicable and least injurious. *Tree wound dressings.* Out of a hundred different materials tested by Dr. R. P. Marshall of Yale University the best are a thin asphaltum, red or white lead paint, shellac and bordeaux paste made of commercial bordeaux powder and linseed oil. *Hedge plants.* Hedges of 125 varieties of plants possibly suitable for clipped hedges have been established for observation at Morton Arboretum and at Cornell University with a view to adding to the very small number of plants now so used.

656. MAZZARON, A. 633.822-1.8
Sull' influenza di concimi diversi sulla produzione e composizione dell' essenza di menta. (**The influence of different manuring on the production and composition of menthol.**)
Ital. agric., 1935, **72** : 557-9, bibl. 5.

The author describes the first year's experiments on the manuring of mint (*Menta romana*) carried out in precisely the same way and in the same botanical garden as those on thyme (see 657). No definite conclusions can be reached by one year's results, but there are indications that K and P help particularly towards the etherization of menthol and that lime favours its formation. The investigation is being continued.

657. MAZZARON, A. 633.88.34.187-1.8
Sull' influenza di concimi diversi sulla produzione e composizione dell' essenza di timo. (**The influence of different manuring on the production and composition of thymol.**)
Ital. agric., 1935, **72** : 472-5.

The author gives an account of the first two years' results of simple manurial trials with thyme (*Thymus vulgaris*) at the Botanical Garden of the University of Rome, the soil chosen having a pH of 7·4. There were five plots, one receiving no manure and each of the others either lime, or potassic fertilizer, or nitrogenous fertilizer, or phosphatic fertilizer, the amounts—which are stated—being those of common practice in the neighbourhood of Rome. Seed was sown in spring on well prepared soil and the crop was harvested at the beginning of July by cutting off the flowers just below the head. Distillation took place immediately. Determinations were made of the weight of fresh product, the percentage of essential oil, the total phenols in the thymol extracted, and the percentage of thymol. In the second year the plants were spaced more regularly in the plots and the same manuring was given. The crops were analysed as before. The results for both years are given. In the second year a great increase was noticeable in the total crop and in the essential oil percentage from the N manured plot and a considerable decrease in the essential oil percentage from the K plot. The essence extracted from both these plots was noticeably very yellow in contrast to that from all the others, where it was the normal straw colour. The investigations are being continued.

658. GERSHOY, A. 635.938.422 : 576.312.32
Studies in North American violets. III. Chromosome numbers and species characters.
Bull. Vt. agr. Exp. Sta. **367**, 1934, pp. 91, plts. 27, bibl. 107.

This bulletin sets forth a detailed study of chromosome numbers, species, characters and the hybridization of species in the genus *Viola*. It is shown that morphological characters which determine the sections and the species do not correlate uniformly with chromosome number and furthermore that chromosome number is not directly related to vigour of growth, to spread by propagating branches, or to spontaneous reproduction of seed. The degree of natural relationship determines, in general, the capacity of species to hybridize. This hybridization potential is only fortuitously related to chromosome number *per se*. In similar fashion the incidence of fertility or sterility in the species-hybrids shows a lack of uniform correlation with chromosome number. [Author's summary.]

659. BOLD, H. C., AND GERSHOY, A. 635.938.422 : 576.312.32
Studies in North American violets. IV. Chromosome relations and fertility in diploid and tetraploid species hybrids.
Bull. Vt. agr. Exp. Sta. **378**, 1934, pp. 35, plts. 15, bibl. 42.
This bulletin deals with a study of the maturation divisions in diploid and tetraploid species hybrids. The bearing of chromosome relations on sporogenesis and the incidence of fertility or sterility is discussed. It is suggested that the stress laid on chromosome configuration in recent karyological studies had tended to minimize an evaluation of the direct effect of developmental tendencies in the hybrid upon the course of maturation. The concept is again advanced that the form of chromosomes and their spatial configuration reflect the phenomenon of flow of chromatin. [Authors' summary.]

660. MCKENZIE, H. L. 635.944 : 632.73
Life history and control of the gladiolus thrips in California.
Circ. Calif. agric. Exp. Sta. **337**, 1935, pp. 16, bibl. in text.
The gladiolus thrips, *Taeniothrips gladioli* M. and S., is widespread throughout the United States, and has also been found in Australia, Africa, Canada, the Hawaiian Islands, and New Zealand. All parts of the plant, leaves, flowers, corms, and young roots, excepting the cormels are subject to attack. The actual damage done is a weakening of the plant. Normal flower opening may be prevented ; the production of new corms may be inhibited owing to foliage injury ; and the corms themselves if severely infested may not germinate. A bleached area on any of these parts may be a symptom of attack. The life history of the insect is described in this paper, and a list of other minor host plants, which include many flowering garden types, is given. The production of clean corms may be assured by any of the following treatments :— 1. Naphthalene flakes sprinkled over the corms when in store at a rate of about 1 oz. to 100 medium-size corms. This should usually be repeated every fortnight, but should not be carried out once sprouting has started. 2. Calcium cyanide fumigation performed twice with an interval of 10 days. 3. Corrosive sublimate (mercuric chloride), 1 oz. to 7 gallons of water, as a dip for an exposure of 17 hours. 4. Hot water at 112°-114° F. for 20-30 minutes will destroy all stages. Two spray mixtures recommended for field treatment are (1) manganese arsenate (68%) 4 lb., brown sugar 66 lb., water 100 gallons, and (2) paris green 2 lb., brown sugar 66 lb., water 100 gallons. Either of these should first be applied when the plants are 2″ high, and thereafter once a week, or after each overhead irrigation.

661. DUSTAN, A. G. 635.944 : 632.73
The gladiolus thrips.
Pamphl. Canad. Dep. Agric., **151** (n.s.), 1935, pp. 11.
The gladiolus thrips, *Taeniothrips gladioli* M. and S., was noticed in Canada for the first time in 1930. It is now widely distributed and continues to spread rapidly, and is regarded as the most serious insect pest of gladioli known. A description of the insect, its life history and habits, and the injury it causes, is given. The thrips is known to pass the winter on corms in storage, but has not as yet been found hibernating successfully out-of-doors in Canada. A study covering four years has shown conclusively that apart from occasional feeding on some other plants the thrips has no other true host. The most satisfactory control would therefore seem to be the treatment of corms during the winter. The following methods are effective :—(1) Naphthalene flakes sprinkled over the corms at a rate of 1 ounce to 100 corms after at least 1 month has elapsed since harvesting. The corms may be put in paper bags, cardboard or wooden boxes, and the containers then closed (but not air tight) for about 4 weeks or more to allow fumigation to take place. A temperature of 70° F. is suggested. Afterwards the naphthalene flakes are shaken out, and a month should elapse before planting. (2) Corrosive sublimate (mercury bichloride) at 1 ounce to 6 gallons of water. Peeled corms should be soaked for 3 hours, and unpeeled for 20 hours. The best time to treat is directly before planting in the spring. (3) Hot water at 120° F., soaking for 10 minutes, as above, just before planting. Where thrips appear in the field, a recommended spray mixture is paris green 1 tablespoonful, brown

sugar 2 lb., water 3 gals. This should be applied at weekly intervals from the time the plants are 5"-6" high until the blossoms start to open. The infestation of corms at harvest time may be largely avoided by cutting off the tops as low as possible and removing the corms at once to be dried elsewhere. Finally storage at lowered temperatures is advocated. Work in the U.S. is quoted as showing that all stages of the thrips are killed at a constant temperature of 36° F. for two months, or of 40° F. for three months.

662. WEINARD, F. F., AND DECKER, S. W. 635.937.34 : 631.544
Effects of prolonged storage on forcing qualities of summer-budded roses.
Bull. Ill. agric. Exp. Sta. **409**, 1934, pp. 10.

The usual method of propagating greenhouse roses is by cuttings or by grafting during the winter in the glasshouse. More recently a method of summer budding has been evolved, by which the stocks are budded in the late summer, are lifted when a union has been made but before growth has started, and are stored in a cool place. Such plants when finally set out in the greenhouse have produced yields comparing favourably with those of winter grafted plants. The principal difficulty encountered has been that the dormant plants are usually sent to growers in January or February, when the plants they are to replace are in full production, and they may have to be potted up until the benches are cleared, with resulting wastage of space. The experiments described in this paper were designed to see if summer-budded plants could be held dormant successfully in storage until the late spring before shipping them to growers. Four varieties of rose were each divided into four lots, and were held over in commercial storage until about the middle of the months, March, April, May and June, when one lot of each was transferred to a greenhouse. Here the March and April lots were again subdivided, half being packed in sphagnum moss, and the other half being potted in soil, but as the former appeared less vigorous once growth started, the May and June shipments were all placed in pots. On July 2nd all the plants of all four shipments, which had started growing, were planted out in the benches. The average number of plants of all varieties started successfully on this date were, March shipment 83%, April 80%, May 77%, June 72%. Further losses occurred after planting and these were approximately, March and April shipments 2%, May 7%, June 14%. Total losses therefore ranged from about 20% for plants held till March up to about 40% for those held till June, and this shows that any postponement of planting beyond the usual time in January or February is liable to be accompanied by serious mortality. In this experiment there was, however, no reduction in yield from increased storage from those plants which survived. In a second smaller trial the effect of paraffining the tops of summer-budded roses of several varieties in storage was shown to be negligible.

663. PRESTON, I. 635.937.34
Hardy roses. Their culture in Canada.
Bull. Canad. Dep. Agric., **17** (n.s.), 1935, pp. 55.

The major portion of this paper is taken up with a list, together with brief descriptions, of a large number of varieties, most of which may be seen at the Central Experimental Farm, Ottawa. Methods of cultivation, winter protection, propagation, and pruning are outlined, while a note is added on the method of artificial pollination used in breeding work. A section on the diseases of roses and their control is contributed by F. L. Drayton, and another on insect pests and their control by A. Gibson.

664. WILDE, J. E. 635.976 : 632.111
Winter hardiness of shrubs at Grand Rapids, Michigan ; winter of 1933-4.
Quart. Bull. Mich. agric. Exp. Sta., 1935, **18** : 24-8.

An abnormally long and severe period of sub-zero weather during the winter of 1933-4 caused considerable damage to a collection of trees, shrubs and vines, which are usually regarded as hardy, at the Graham Station, Grand Rapids. A limited water supply both in the autumn and in the spring intensified the injury. The collection, which appears to be very extensive, was classified on the amount of damage apparent during the following growing season, and the lists

of shrubs and other ornamental plants supplied should be useful as an indication of the relative degree of winter hardiness which may be expected in each type. It is of interest to note that although the temperature fell as low as – 24° F. in February the number of shrubs killed outright was not very great, and the main damage took the form of loss of symmetry owing to branch injury, and the loss of the 1934 crop of flowers in a large number of cases.

665. Allard, H. A. 612.014.44
Response of the woody plants *Hibiscus syriacus, Malvaviscus conzattii* and *Buginvillea glabra* to length of day.
J. agric. Res., 1935, **51** : 27-34, bibl. 1.

The flowering responses of three shrubs subjected to different lengths of day were as follows :— Shrub-althea, *H. syriacus* L., proved a typical long-day plant. Exposures of less than 12 hours daylight were unfavourable to flowering. Abundant flowering was associated with the upper limits of a 12 or 12·5 to 15 hour day. The turkscap hibiscus, *M. conzattii* Greenman, showed little response to length of day, but the plants were more compact and flowered more profusely under shorter daily exposures between 10 and 13 hours. Bougainvillea, *B. glabra* Choisy, is a typical short-day plant. Flowering was quickly initiated by restricting daylight to 10 hours during midsummer, whereas exposure to 12 hours daylight was distinctly less favourable to flowering. The author concludes :—" It is evident that the usefulness of all these plants for certain seasons and regions depends as much upon their particular length-of-day requirements as upon any other factor."

CITRUS AND SUB-TROPICALS.

666. Hu, C. C. 634.3
The history and distribution of citrus fruit in China. [Chinese-English summary.]
Bull. Coll. Agric. For. Univ. Nanking, China, **31** (n.s.), 1934, pp. 79, bibl. 62.

This paper should be of interest to persons studying the sources of origin of Citrus species, and their present distribution in the Far East. Indigenous types such as *Citrus junos* Tanaka, *Poncirus trifoliata* Raf. and *Fortunella* spp. and numerous introductions into China are mentioned. Some of the records go back over 4,000 years. As regards present commercial types the author considers that too few summer oranges, lemons, and grapefruits are cultivated in China, and that steps should be taken to increase plantings. A lengthy bibliography is appended. [From author's summary.]

667. Anon. 634.3
Investigations into citrus problems.*
J. Coun. sci. industr. Res. Aust., 1935, **8** : 239-41.

(1) *Preservation and transport of oranges.* Investigations are to be conducted on uniform lines at Newcastle, Melbourne and Griffith. Thorough investigation is to be made into the preservation of navel oranges and will include enquiry into influence on keeping qualities of rootstock, strain, environmental factors and picking maturity. Experiments will also embrace types of sweating, processing and wrapping. (2) *Investigations in Lower Murray Valley* include control of red scale, fertilizers, irrigation problems, etc. (3) *Control of fruit fly.* Biological control of this pest and of the white wax and white louse scales is being sought for and an entomologist is now visiting Ceylon, India and West Africa in order to get and forward parasites to Australia.

668. C.S.I.R.Aust. 634.3
Citricultural Research Station (Murrumbidgee irrigation areas), Griffith, N. S. Wales.
8th Annu. Rep. Coun. sci. industr. Res. Aust. for 1934, 1935, pp. 40-1.

The work of the station includes a comprehensive study of green manuring, fertilizers, soil moisture and cultural problems on an irrigated area of 28 acres of oranges. *Green manuring.*

* By C.S.I.R. Aust.

The growth of a winter legume as a green manure has resulted in an increase in yield of 33%. The structure of the soil is, moreover, maintained by the process, thus facilitating tillage and irrigation. The nitrate relationships of the green manured plots are being studied. *Fertilizers.* Mature but not young trees respond to nitrogenous manuring. Although citrus trees do not respond to superphosphate, this is necessary for the growth of green manure. *Biennial bearing.* Investigations here have shown that blossoming and setting depends on the size of the previous crop. Fruit thinning offers promise of remedying this and is under investigation. *Cool storage.* Experiments are in progress. *Irrigation.* Waterlogging and soil salt troubles arising from faulty methods of irrigating are under investigation. Work continues on furrow methods of irrigation. *Spray irrigation* is found to be a useful method on soil types where surface methods are difficult. A special pamphlet is promised on this shortly.

669. GREGORY, E. J. 634.323 : 581.144.2
Citrus root studies in Trinidad. A preliminary investigation on grapefruit.
Trop. Agriculture Trin., 1935, **12** : 278, bibl. 9.

The root systems of 4 three-year-old Marsh grapefruit were excavated and compared. Two trees had received a complete fertilizer plus pen manure and an annual hoeing and forking. Two trees had received no manure and a twice yearly cutting of the weeds. The fertilizers had been placed in a ring round the tree just under the outmost spread of the branches. Growth measurements of comparable trees in the same area have shown 100% growth increment of manured against unmanured trees. Lateral roots of manured trees exceeded the average spread of the branches (42 inches), but the majority of their feeding roots occurred at a distance of 3-18 inches from the trunk. The lateral roots of the unmanured plots were shorter, their feeding roots being situated 3-12 inches from the trunk (branch spread 23 inches). It is recommended that in future fertilizers should be spread evenly over a wide circle starting 3 inches from the trunk. Only thus can the plant get the full benefit of the manure.

670. BARNES, A. C. 634.3
(Jamaica) Government's citrus credit scheme.
J. Jamaica agric. Soc., 1935, **39** : 477-81.

A scheme to finance citrus growing in Jamaica has been drawn up by the Director of Agriculture for submission to the Legislative Council. The scheme, which is here detailed, contains the following points and recommendations. The Government of Jamaica have taken the following measures to encourage citrus production in the island. (*a*) A packing house has been erected at Kingston and leased to the Jamaica Citrus Producers' Association. (*b*) Large nurseries have been established for the production of budded plants of standard varieties. These are sold at low prices to planters. (*c*) Field services are provided to assist growers. (*d*) The quality of fruit for export must conform to certain standards. (*e*) Efforts are being made to extend the overseas markets. Recommendations made under the scheme are the establishment of new orchards and the topworking of existing trees to standard varieties. To achieve this, assistance would be offered to persons possessing not less than 25 acres of suitable land, of which not less than 5 is in one block. The maximum acreage for which assistance would be given is 20 and the minimum 5. Persons desirous of planting more than 20 acres might be assisted in respect of the first 20 acres. Assistance should take the form of supplies of plants—the charges for which should form part of the total loan debited to the planter—a sum of money not exceeding £5 per acre to assist in preparing the land, and an annual sum not exceeding £1 per acre for maintenance for four years. Interest on outstanding amounts should be charged at 5% and repayments of accumulated interest and of the capital advanced would begin in the 7th year and continue until the final payment in the 10th year. Persons receiving such loans would have to cultivate their land in accordance with the directions of the Agricultural Department. If the scheme were fully operated, 800 acres in the proportion of 3 acres of grapefruit to 1 acre of oranges could be planted, the yield in the 10th year being estimated at 224,000 boxes with a

f.o.b. value, packed for export, of £84,000 at present prices. The topworking of all suitable trees with the seedless grapefruit is advocated. Such trees can be brought again into bearing in 3 years. The seedy grapefruit has practically lost its place in the world's markets. The recommendation is made that a limited number of trees should be topworked free of charge for planters.

671. CROUCHER, H. H. 634.3-1.547.6
Maturity tests for citrus.
Bull. Dep. Sci. Agric. Jamaica, **5** (n.s.), 1935, pp. 8, bibl. 4.
Various tests for indicating the maturity of citrus fruits have been devised in different parts of the world. In Florida and elsewhere the total solids : acid ratio is commonly used, but appears to possess the disadvantage that no one standard minimum for oranges of, say, 8·5 : 1 is suitable for fruits from all regions. More recently titratable acidity determinations have been adopted in New South Wales. The acidity standard is 23, expressed as c.c. of 0·1 N caustic soda required to neutralize 10 cc. of juice, sweet oranges and grapefruit having acidities of less than 20, and acid oranges more than 26. Under conditions in Jamaica, however, this test has not proved entirely satisfactory, but it has been found that the titratable acidity : pH value in millivolts ratio may afford a possible indication of maturity. In this case it appears that a minimum of 12 : 1 should be used. These and various other determinations were made, and a number of ratios compared for oranges and grapefruit collected throughout the ripening and harvesting season in Jamaica, but only one possible alternative test is suggested. This is based on flavour as indicated by the "sharpness" or "sweetness" of the juice. Laboratory tasting trials showed that 3·0-3·5 grammes of sugar (sucrose) could sweeten 1 grm. of citric acid. Thus immaturity in the fruit was represented by sugar $<3\cdot5$ acid, and stages over maturity by sugar $>3\cdot5$ acid. For oranges it was calculated that the amount of sugar present equalled $\frac{2}{3}$ (°Brix $-5\cdot25$) and for grapefruit $\frac{2}{3}$ (°Brix $-3\cdot25$). Therefore to estimate the sugar : acidity factor ratio the minimum for oranges should be (°Brix $-5\cdot25$)$-5\cdot25$ Acid $=0$ and for grapefruit (°Brix $-3\cdot25$)$-5\cdot25$ Acid $=0$. Negative values show non-maturity, positive values maturity. Conclusive results as to the use of this test have not yet been obtained, but it is proposed to submit it to a thorough trial in the near future.

672. UPHOF, J. C. T. 634.334
Die Kultur der Zitronen (*Citrus Limonia* Osbeck). (**Lemon growing.**)
Tropenpflanzer, 1935, **38** : 288-98, bibl. 7.
The author gives a brief survey of lemon growing with special reference to its most important centre, Sicily. He discusses common practice in the field including harvesting. He considers Californian practice and the methods of packing and transport adopted there. He describes briefly the fruits of some 11 varieties commonly grown in California. Finally, he gives a few notes on the so-called sweet lemons of India and on the sweet Italian lemon.

673. PREST, R. L. 634.334
Lemon growing in Queensland.
Qd. agric. J., 1935, **44** : 202-4.
Selected rootstocks combined with scions from trees of known performance and suitable soils and climatic conditions have resulted in the Queensland lemon being, it is claimed, the equal or superior of the Californian and Italian fruits. The suitability of a soil for lemons depends largely on its physical properties. The importance of maintaining the humus content is stressed and in the event of farmyard manure at the rate of 20 tons to the acre being unobtainable, it is suggested that a green manure should be grown. A suitable annual fertilizing programme with artificials for mature trees would be 6 cwt. sulphate of ammonia, 4 cwt. phosphoric acid, 2-3 cwt. potash. The nitrogen should be given so as to be available in the spring. The use of the soil auger is advised in order to determine irrigation needs. The deep sandy soils on which many of

the groves are situated would probably benefit by more frequent waterings than they at present receive. Instructions for pruning are given. The practice of pruning a young lemon tree severely in order to build a strong framework is deprecated. There should be an initial heading back at planting to ensure a strong straight stem with three or four radiating main branches. Subsequently laterals are shortened back, but 6 main upright shoots are left as leaders. As these become weighted down, strong side shoots will arise. Most of these are shortened to make fruiting spurs, and a number are left to take the place of former leaders. The tree is thus built up with a series of irregular tiers of branches bending from an upright position and bearing productive side shoots. Vigorous vertical shoots which do not bear by reason of their vigour are by this method kept in abeyance. Side shoots when cut should be shortened into the ripe wood to throw the sap into the dormant buds. Rank growth is suppressed unless required to replace a leader. Lower limbs which drag down too low are in due course removed. The fruit is ready for picking when its dark green colour begins to lighten. After picking the lemons are first sweated for several days on shallow trays and then stored in a chamber in which the humidity can be maintained at 85-90%, the cases being stacked in such a manner as to permit free circulation of air. In the absence of such a chamber the lemons, wrapped or unwrapped, can be packed in paper lined cases and stacked in batches of 50 cases in a cool dry shed and covered with a canvas sheet. Humidity can be maintained when necessary by means of low open water containers disposed about the shed. Lemons may also be wrapped in sulphite tissue papers and packed in layers of fruit alternating with layers of chaff. Dipping the fruit in 1 : 500 bluestone solution before packing will reduce the incidence of fungal attack.

674. DALLAS, W. K. 634.334-1.821

Effect of liming lemon-trees at Tauranga.

N.Z.J. Agric., 1935, **51** : 163-5.

This is a summary of interim results covering the first four years of the experiment, beginning September 1930. The trees used were 11-year-old Lisbon lemon on sweet orange stock planted 2 ft. apart on a flat area with a light, pumice-type soil. The layout consisted of 5-tree plots replicated 4 times and provided with guard rows. The treatments were (1) no lime and (2) 2 tons carbonate of lime per acre in 1930 and 1 ton per acre in July 1932. Annual dressings of superphosphate 6 cwt., sulphate of ammonia 6 cwt., and sulphate or muriate of potash 3 cwt. per acre, were applied annually to both treatments and in the winter of 1934 a dressing of 46½ lb. of carbonate of lime per tree was given to both treatments to neutralize any increase in soil acidity. Cover crops of lupins sown in 1931 and 1932 showed no difference in growth as between the two treatments but crops of weeds in the subsequent years were much heavier on the limed plots. At the end of the 4-year period there was a small increase in yield [about 9%—ED.] in favour of the limed plots, but this was not considered statistically significant. There were no apparent differences in quality of fruit.

675. SHAMEL, A. D. 634.334-1.547

Relation of foliage to fruit size in the Eureka lemon.

Calif. Citrogr., 1935, **21** : 4, bibl. in text.

Four fruit-bearing branches on the north side of each of 3 lemon trees were girdled at their junction with the main stem, and the number of leaves per fruit altered to 15, 25, 40, and 60 respectively. Controls consisted of untouched branches situated on the north side of 3 trees, and though not strictly comparable they are sufficient to indicate the normal growth on these trees. Monthly fruit measurements were made and are shown graphically. The rate of growth was found to be correlated with the number of leaves per fruit, those with more foliage producing more rapid growth and larger fruit. About 25 leaves per fruit on girdled branches equalled fruit growth on normal branches. Since the size of fruit appears to depend in part on the leaf area per fruit, the selection of strains and rootstocks can be made and cultural methods adopted which will favour abundant foliage production, especially in those districts where conditions for developing the larger and more profitable sizes of fruit are difficult.

676. Bartholomew, E. T., and others. 634.31-2.19
Granulation of Valencia oranges.
Calif. Citrogr., 1935, **21** : 5, 30.

The granulation (crystallization) of Valencia orange fruits is being studied. The problem is complicated and results only are given here. Attempts to interpret them are not made. (1) *Survey.* The extent, severity and complications of the problem were examined in Valencia orange groves from Irvine to Santa Barbara in 1930. (2) *Time of picking.* In 1930 fruit of 13-year-old Valencias at the Citrus Experiment Station picked in the last week in July showed no granulation. Later pickings in September, October and November off 10 trees whose crop had not been touched that season showed 55·8% of the fruit to be granulated. (3) *Trees under shade tents.* 4-year-old trees under separate cheese cloth tents closed or ventilated, as also their controls, showed no granulation, but 5 4-year-old trees under a common cheese cloth tent showed 17% granulation while the controls showed 35%. This is not to be taken as evidence that the decrease in granulation was due to the presence of the tent. (4) *Growth rate of fruits.* Volumetric measurements by displacement showed that more granulation occurred in rapidly growing fruits than in slow ones, but it did not appear to be caused by more rapid growth of the stem end half. (5) *Lime spray.* Trees sprayed with whitewash in 1932 had about 50% less granulated fruit than the controls and the severity was less. (Lime spray is supposed to cause fruit to lose water more rapidly.) (6) *Other sprays and dipping.* Tests were made to show whether the reduction of granulation was due to the white colour or to the chemical activities of the lime. Starch-barium sulphate spray (white but no lime) reduced granulation 23%, calcium nitrate (lime but no white) about 10%. Dipping 2,000 of the largest fruits on 20 trees in whitewash had no effect. (7) *Lime spray.* Differences were less marked in 1934 when lime sprays were again applied in varying strengths but all weaker than in 1932. However, granulation was not pronounced anywhere in 1934. (8) *Scaly-bark gummosis*, either on the bark or present in the virus form, did not appear to affect granulation on 80 trees in 1934. (9) *Individual tree variation* in the production of granulated fruit is very marked. This has considerably hampered the interpretation of the experiments. (10 and 11) *Transmission through the bud.* Experiments are in progress to discover whether the tendency to granulate or not to do so can be transmitted by the bud graft to the resultant tree. Test trees have not yet fruited. (12) *Budding on to tangelo.* Buds from a practically immune tree (which adjoined a badly granulating tree) were inserted on a Sampson tangelo 10-12 years old. In the 3rd year fruit from these buds was badly granulated. (13) *Rootstock effect* is being examined. (14) *Irrigation.* A reduction in the amount of water *seemed* to result in reduced granulation. (15) *Biochemical.* Granulated juice sacs compared with healthy ones contained more water but only about half the amount of sugar. Pentose and pentosan content is the same in the juice sacs and peel of healthy and granulated oranges. (16) *Position of occurrence.* In 1935 granulation was unusually noticeable in the centre and stylar parts of the fruit with often little or none in the stem end.

677. Camp, A. F. 634.3-2.111
Some lessons learned in two freezes.
Calif. Citrogr., 1935, **21** : 23.

This article is a resumé of a paper published recently by Dr. Camp in the *Florida Grower* (date not stated). The point is made that while orchard heating may save citrus groves in cold districts on occasions, it would be more profitable to establish groves only in the better protected places. Experience both in 1928 and last winter showed that the strong vigorous trees consistently proved more resistant than the under-nourished trees. The theory that the thin trees are tough and resistant to cold has been completely disproved. Varietal differences in hardiness were very slight. If anything tangerine trees were a little hardier than orange or grapefruit, though the fruit was easily damaged. The differences in rootstock influence were also slight, but trees on vigorous rootstocks were slightly hardier. Orchard heating to be effective must be properly understood, and accurate and properly placed thermometers are essential. Choice of fuel would depend largely on price. One pound of oil will give off 19,000 heat units, 1 lb. of coke 14,000 and 1 lb. of wood about 8,000-9,000. Wood is the cheapest fuel but requires more labour and is more difficult to control.

678. ATANASOFF, D. 634.3-2.42
Infectious chlorosis of citrus or mal secco.
Commun. 11 ème Congr. Int. Hort. (Rome), 1935, pp. 4, bibl. 1.
The author claims that the destructive disease known as *mal secco*, which has so badly attacked citrus trees in the Mediterranean countries, is not caused by the fungus *Deuterophoma tracheiphila* as has hitherto been supposed, but is due to a virus* disease, the fungus which is invariably found in the wood tissues of the diseased plants being merely a secondary infection. He considers the disease to be identical with Florida citrus blight and wither tip, the causes of which, he says, are unknown.

679. RUGGIERI, G. 634.31-2.411
Una grave epidemia di marciume radicale fra gli agrumi di Fondi (Littoria).
(A severe epidemic of foot rot (*Phytophthora* sp.) in the citrus groves of Fondi.)
Ital. agric., 1935, **72** : 515-8, bibl. 5.
The sweet orange trees of Fondi are suffering more and more from the ravages of foot rot. They are very largely on their own roots and it has in the past been found that grafting on sour orange results in delayed fruiting and in the production of a thick-skinned inferior fruit when compared with grafting on sweet orange or growing from seed. The writer notes the immunity of sour orange to the disease and considers it essential that all new planting should be done on this stock. At the same time he recommends that Sicilian varieties such as Moro, Ovaletto Sanguigno, and Tarocco of the blood oranges and Biondo Nostrale Liscio should be given a trial at Fondi. They are known to be compatible with sour orange and might do well under Fondi conditions. He advises that strict sanitary precautions should be taken at once to isolate the remaining healthy trees from infection and should include (*a*) the removal of all infected plants, the holes to be disinfected with quick lime or copper sulphate, (*b*) the ruthless total destruction of all nurseries of the native sweet orange variety, (*c*) the setting up of a small ridge of soil about 9 inches across at some 12 inches from the trunk of each tree and inserting therein 2 or 3 times between the end of the winter and the following autumn 50-60 gr. of copper sulphate. In the process of making this ridge the trunk should be cleared of soil down to the top of the chief roots. During irrigation no water must be allowed to enter the ring. The soil next to the trunk should not become moist during late spring and summer, since warm humidity is a condition particularly favourable to the spread of *Phytophthora*.

680. KLEIN, H. Z. 634.3-2.951
Trees damaged during pest control operations.
Hadar, 1935, **8** : 193-5.
Damage caused by spraying with white oils. The hot wind which blows in Palestine occasionally from the end of April to the middle of June and during September-October causes severe damage to recently sprayed citrus fruits, even to fruit sprayed a fortnight previously. The injury takes the form of large brown spots having a dark centre which develop on the exposed side of the fruit and later become flattened or sunken. Spraying during the noon heat causes similar damage. Leaf fall is occasioned by spraying trees that require water. A warning is given against careless preparation of emulsions and against the application of too heavy a dose. Photographs are reproduced of 5-year-old trees which dropped most of their fruit after single sprayings of 30 and 40 litres respectively with a white oil emulsion. The use of efficient machinery is urged. The author has seen a large citrus grove in which at regular intervals throughout the grove a pair of trees were burned so badly that they died. This injury was traced to the fact that the agitator in the machine used did not reach the bottom of the container and thus the residue of the mixture was unstirred. *Fumigation damage* consists in leaf and fruit drop, leaf burn and the appearance of hard corky areas on the fruit. Time and season are important factors in fumigation and these are to be fixed in Palestine for each district separately. In the Jordan valley during night fumigation much damage was caused nightly to the eastern

* Atanasoff considers bitter pit to be another virus disease. *H.A.*, 1934, 4 : 2 : 216.

sides of the rows of grapefruit which were fumigated just before dawn. On this occasion oranges and tangerines under the same conditions suffered, although much more lightly, while acid lemon trees were quite unhurt. *Sulphur dusting*, during the hottest period at the end of July and in August, causes burning of leaves and fruit. At other times of the year there is no burning from this cause. *Banding* trees against ants, the linen or parchment bands on the trunk itself being smeared with tanglefoot cart grease, etc., results in burning of bark and cambium whenever the banding mixture has touched the bark. *Damage caused by cleaning fruit.* Fruit badly damaged by sooty mould (which should have been controlled by spraying in the orchard) was cleaned in packing houses by wiping with a cloth ; occasionally, the author states, the workman would first spit on the fruit and then scratch the mould off with his finger nails. Even without these two additional aids wiped fruit showed 25% decay six weeks later while comparable unwiped fruit showed only 9%. The fruit in this experiment was specially selected for quality. Unselected fruit might suffer even more.

681. McGregor, C. J. 633.85

Notes on the tung oil tree.

East Afr. agric. J., 1935, **1** : 127-30.

The article describes the cultivation of the tung oil tree (*Aleurites Fordii*) in Florida and Southern Georgia, U.S.A., at the present time. Propagation is by selected seed, though patch and ring budding in spring with buds of the current season have been successful. Cuttings have failed to root. The seedlings are raised in nursery rows and transplanted when a year old and from 3 to 6 ft. high to their permanent positions, the recommended spacing being about 30 ft. × 30 ft. The trees must be dormant at the time. The tree is a surface feeder so that cultivation is shallow and mulches are preferred. In established plantations the dense shade provided by the branches will keep the weeds in check. Low branching is desirable and, since many trees do not develop this habit naturally, it is produced artificially by cutting back the tree heavily when transplanting. The practice is also said to increase the yield. Pinching the terminal bud merely causes the tree to throw further vertical growth. Branching is also produced by the removal of a strip of bark ¼ inch wide and 1½ inches long just above the bud which it is required to start into growth. Cover crops of crotalaria, velvet beans and cowpeas planted a few feet from the trees between the rows are beneficial. The crop is gathered from the ground where it can safely be left for 2 or 3 weeks after the seeds have fallen in late autumn. Information as to the most suitable soil types is scarce, but the tree is suited by a light, well-drained sandy loam with a slight acid reaction. The degree of acid tolerance is unknown. A pH of above 7 produced bronzing of the foliage while normal growth was maintained at pH 6·10. Excess of phosphate has also been found to be detrimental to growth. A study of the bud differentiation has shown that a season's crop is dependent on the tree being in thrifty condition the previous year, which necessitates the maintenance of a high soil fertility. That there may be a great difference between the yields of the individual trees is shown by a test with only ten trees over 18 years in which two trees bore more fruit than the total yield from the remaining eight. The yield from 7-year-old tung trees under present conditions is 1,200 lb. per acre. It is estimated that by topworking and an adequate fertilizer programme this could be raised to 1,800 lb. per acre. To get profitable results it is necessary to treat the tree not as a forest tree but with the care accorded to a delicate, heavy yielding fruit tree.

682. Mowry, H., and Camp, A. F. 633.85-2.19

A preliminary report on zinc sulphate as a corrective for bronzing of tung trees.

Bull. Fla. agric. Exp. Sta., **273** : 1934, pp. 34, bibl. 24.

" Bronzing " is a term used in Florida to describe an unthrifty condition of tung trees, and has in the past been the cause of considerable losses in groves. It is a non-parasitic disease and its severity varies from bringing tree growth to a virtual standstill to causing death within two or three seasons. The first noticeable symptom is the appearance of bronzed discoloration in few or many leaves. This seldom appears with the first spring growth, but may be seen later. The first discoloured leaves may be normal in other respects, but subsequent leaves become

smaller, and finally severe malformation of the terminal leaves becomes apparent. The foliage later takes on a typical dark bronze colour, spotting occurs, and parts die and fall out giving a ragged appearance. Partial or complete defoliation frequently follows. During the first season one branch only may be affected, but ultimately the whole tree shows bronzing, and the disease becomes progressively worse. Affected trees are apparently much weakened and become predisposed to cold damage during the winter, twigs and sometimes whole branches being killed back by only moderate frosts. Subsequently during the second summer further dying back of newly formed twigs frequently occurs. The experiments described in this paper were started in 1931, and were designed to test the effect of zinc sulphate on diseased trees. Up to the present the amount of zinc to apply, the time to apply it, and even the best way to apply it have not been determined, but the results of various trials indicate that zinc sulphate is a specific treatment for the trouble, when applied either to the soil or as a spray. This is supported by the appearance of severe chlorosis in Satsuma oranges, rosette in pecan trees, and " white bud " of corn in the same or adjacent fields to bronzed tung trees. All responded to zinc sulphate treatment. The two tung-oil species, *Aleurites Fordii* and *Aleurites montana*, were affected in different degrees under the same soil conditions, but both responded to treatment. In young groves under 4-years-old where a small amount of bronzing has occurred, it is suggested that a general application of about ¼ lb. 89% zinc sulphate, or its equivalent, should be applied per tree in April or May. This may be followed by additional applications to trees which still show bronzing. Where soil treatment proves ineffective, spraying with 5 lb. zinc sulphate and 5 lb. lime to 50 gallons water is recommended for experimental trial. Finally, a note of warning is added to the effect that three types of zinc sulphate may be encountered, differing on a basis of water of crystallization content. These are $ZnSO_4.1H_2O$, $ZnSO_4.5H_2O$, and $ZnSO_4.7H_2O$, and contain respectively about 89%, 63% and 56% zinc sulphate. Any of them may be used, but the price paid and the amount applied should be based strictly on the zinc or zinc sulphate content.

The following also is noted :—

Finch, A. H., and others.
Progress on the control of citrus chlorosis or decline. *Proc. Amer. Soc. hort. Sci. for 1934*, 1935, **32** : 20-3.

TROPICAL CROPS.*

683. Beckley, V. A. 631.45
Soil erosion.
Bull. Dep. Agric. Kenya, **1** *of 1935*, pp. 76, bibl. 29.

The changed conditions of agriculture in East Africa in common with many other parts of the world have resulted in enormous increases in soil erosion, so that over vast areas of land the problem of soil conservation has become by far the most urgent consideration in the maintenance of any form of arable farming. The present paper reviews this problem in all its aspects, and in particular deals fully with measures for controlling the evil. The reclamation of gullies with check dams, the uses of vegetation, cultivation, silt pits, drains, and terracing are all discussed in detail.

684. Beckley, V. A. 631.87
Organic manures with special reference to composts.
Bull. Dep. Agric. Kenya, **9** *of 1934*, pp. 45, bibl. 12.

Following a general account of the purposes and effects of adding organic matter to soils, and of cover cropping and mulching, the author discusses two main methods of composting, the simple and the Indore, with reference to their application to East African agriculture. Specific instructions as to the system to be followed with several different waste products are given in

* See also 633.

three appendixes. Among these the utilization of coffee pulp is described. The usual process is to run the wet pulp on to layers of roughage where, becoming compacted, undesirable anaerobic acid fermentation takes place. In cases where a fair amount of roughage is available it is recommended that the pulp and roughage should be built into low narrow heaps in alternate layers. At two-week intervals the heaps should be turned so as to mix the dry pulp on the outside with the wet pulp inside. After 8 or 10 weeks a black, structureless mass, smelling of ammonia, should be formed. Where hulling and pulping are done in the same place, the addition of the parchment to the initial heaps will help to promote aeration. [Persons obtaining this useful bulletin should note that the page numbers given in the contents are incorrect, and with the exception of the introduction on page 1, 2 should be added to each figure given.—Ed.]

685. Milsum, J. N. 632.951.1
Cube or haiari root.
Malay agric. J., 1935, **23** : 426-7.
The Black and White Haiari (cube root) are two species of *Lonchocarpus* (*Leguminosae*) at present not further identified. The plants used in South America as a fish poison are cultivated in Peru and shipped to the United States, where in powdered form they have a value as an insecticide. The toxic property is rotenone which ranges from 4-6% with ether extract of 12-18%. Plants of both varieties were sent to F.M.S. from Kew in November, 1932. White Haiari, a rambling shrub with whitish stems, propagates easily from branches pegged down below the soil, while stem cuttings of strong mature wood will root under shade. Black Haiari is an erect shrub with dark brown to black stems and has, so far, grown too slowly to provide propagating material. In root samples taken 25 months after planting out the rotenone content was found to be considerably below that of good derris. This may possibly be due to immaturity, since the Indians in S. America consider the root unfit for use until 4 or 5 years old.

686. Buckley, T. A. 632.951.1
Tuba root (*Derris* sp.).
Gen. Ser. Bull. Dep. Agric. S.S. & F.M.S., **21**, 1935, pp. 25-7.
The following data have been obtained during 1934 by the Division of Chemistry. The toxic content of plants raised from cuttings of any given strain of *Derris* does not alter under the influence of different soils or localities. It has been found that *D. elliptica* and the erect Sarawak, *D. malaccensis*, grown at Serdang showed a large fall in ether extract and rotenone content at 33 months compared with roots at 26 months old. At Kuala Lumpur, however, *D. elliptica* showed improved toxicity at 33 months and *D. malaccensis* slight deterioration. The optimum age for harvesting is thus somewhat uncertain, but present estate practice of harvesting at from 24 to 26 months is probably sound. Manurial treatments of five species of *Derris* were disappointing as regards increase in yield and toxicity. The milky extract made by pounding fresh roots and squeezing in water contains 90 per cent. of the rotenone and other ether soluble bodies existing in the root and is a successful insecticide. The toxic bodies can be precipitated by adding milk of lime to the extract, and when dried and ground the precipitate forms an efficient insecticidal dust. (It was found that this action of lime had been previously discovered and patented.) Rotenone does not seem to be an internal poison for insects. Cockroaches were fed for a long period on a mixture of rotenone and tapioca flour without ill effect. Their excreta proved to be a mixture of rotenone and a body easily reconverted to rotenone.

687. Grist, D. H. 632.951.1
Derris (Tuba root).
Malay. agric. J., 1935, **23** : 477-82.
This article is a summary of information on derris and is a chapter published in advance from a book on Malayan Agriculture shortly to be issued by the Department of Agriculture S.S. and F.M.S. Two species are cultivated in Malaya, *D. elliptica* Benth. a non-indigenous, creeping species which forms a close cover, the stems rooting at the internodes, and *D. malaccensis* Prain. var. *sarawakensis*, an erect species indigenous to Malaya. There are numerous varieties of

D. elliptica of varying degrees of toxicity, so that the selection of a variety for planting should be done with care. Propagation is by stem cuttings in nurseries sited on moist land, the beds being covered with a layer of lalang grass to conserve moisture. Cuttings so treated are ready for transplantation in six weeks. If unrooted cuttings are planted direct on to their permanent site, the leaves should be removed to lessen transpiration. Direct planting entails losses which should be replaced immediately. The most suitable soil is light and sandy, correct spacing is 3 feet apart or 4,840 plants per acre. The optimum age of harvesting, i.e. when toxicity is at its highest, is when the plants are 24 months old. The roots alone are toxic and of these the smaller roots, about pencil size, have the greatest value. They are either artificially or sun dried and should be baled immediately afterwards to prevent attacks of boring beetle. The yield of air-dried root is 1,000-1,200 lb. per acre. The local insect pests are described. There are no serious fungus diseases. Although the rotenone content was at one time considered as the index of toxicity, and still is so in America, three additional effective toxic compounds have been isolated—deguelin, tephrosin and toxicarol. These are represented in the total ether extract and it is recommended that the root should be valued on this rather than on the rotenone content.

688. Nutman, F. J. 633.526.23

The length of sisal fibres with particular reference to grading problems.

East Afr. agric. J., 1935, **1** : 101-3, 106.

Any grading of sisal has hitherto been on a length basis, and will so remain. Grading for fibre strength or fineness appears to be impractical. The present methods of grading consist of leaf selection on the feeding table for length and freedom from damage or selection for leaf length in the field. Both methods are shown to be troublesome, ineffective and expensive. They are designed to separate the sisal into two grades based on the length of a hank of fibre, the hank consisting of all the fibres of one leaf. This is a very different thing to the length of the individual fibres, though by a natural confusion of thought the tendency is to identify them. Actually in any leaf the percentage of fibres shorter than suitable grade length is very considerable, and variation ranges from a few inches to the full length of the leaf. (A leaf contains approximately 1,000 fibres.) Furthermore there is a doubt whether a product consisting entirely of long fibres would be appreciated by the manufacturer. Grading by length of hank therefore appears destined to continue, particularly as other good qualities of sisal fibre appear to be correlated with length of hank. The problem appears then to demand a mechanical grader which will eliminate personal error. This has been satisfactorily accomplished on one estate where a simple attachment to the decorticator estimates the length of the leaf for which the machine is set, sends those under length through the machine side by side with the longer fibres and discharges them through a separate exit. Thus the fibre is produced in two grades based on the maximum length of the hank from each leaf, the cutting of short leaf ceases to be a worry, and the sorting gang becomes unnecessary. No grading can make sisal a uniform product, but it can precisely define its variation.

689. Evans, H. 633.61 : 581.144.2

The root system of the sugar-cane.

Emp. J. exp. Agric., 1935, **3** : 351-62, bibl. 8.

A number of different methods for the examination and study of the roots of growing plants are described in detail together with certain modifications introduced by the author in adapting them to work on sugar cane in Mauritius. The sugar cane system consists of 3 classes of roots:—superficial absorbing roots, buttress roots growing obliquely into the soil to a depth of 2-5 feet, and deep roots mostly associated as rope systems, the strand consisting of from 5-20 roots, the higher number being at the lower depths. The formation of these rope systems is attributed to lack of aeration in the subsoils. A root forming a channel is joined by other roots on account of the better aeration, which is improved still further as more roots appear. The rootlets do not grow outwards owing to lack of oxygen but curl round the parent roots and all descend into the soil together. In addition to poor aeration the subsoils of Mauritius are regarded locally as

being peculiarly toxic. Rope systems, owing to the depth to which they penetrate and their great absorbing capacity, are able to supply the plant with water even in cases of extreme drought.

690. Gilbert, S. M. 633.73

1st Annu. Rep. Coffee Res. and Exp. Sta. Lyamungu, Moshi, Tanganyika, for 1934, 1935, pp. 5.

The report is concerned chiefly with the initial work necessary to the establishment of a new experiment station. The total area is 310 acres of which 4 have been already planted with coffee partly in the form of a collection of types and species. It is pointed out that owing to the suspected variability of yield of *Coffee arabica* and the almost entire absence of individual tree yield records caution will have to be observed in the experiments planned, and it is not intended to proceed with any which under these conditions do not show a reasonable chance of producing trustworthy results. Thus experiments planned now may not be planted for some years until fuller knowledge of the material is available. Two experiments so far have been laid down, one on soil erosion and one on methods of cultivation. As a preliminary for future experimental work growth measurements and records of cherry yields of a total of about 10,000 trees of different varieties and ages and growing under various types of soil and climate have been obtained for the first year on 14 estates. By this means it is hoped that after a few seasons it may be possible to select mother trees strong in desirable characters as for instance yield, broadness of bean, disease resistance and suitability to various soils and climates. From these records too the minimum number of trees necessary per experimental plot to obtain accurate results will be ascertained. Various methods of propagation are being studied.

691. Thomas, A. S. 633.73

Types of robusta coffee and their selection in Uganda.

East Afr. agric. J., 1935, **1** : 193-7.

Robusta coffee, the botanical name of which on grounds of priority should be *C. canephora* Pierre, comprises a group of forms which vary greatly both from genetical and environmental reasons. Those in Uganda fall into two main groups, namely Robusta, originally grown from seed imported from Java, and Nganda, derived from the seed of native coffee. The Robusta types usually form erect bushes, with a few main stems, while Nganda as grown chiefly by the natives tends to form a large spreading tree. Exceptions, however, are numerous. Advantages of the erect Robusta types are rapid growth, early first bearing, large bean. Disadvantages are that they quickly show symptoms of die-back if neglected, and that they require specialized pruning. Advantages of the Nganda tree type are seen in a slower growth and consequently a tougher and less brittle wood than Robusta. The branch spread of 20-25 feet produces, moreover, a dense shade which keeps down grass and weeds, thus eliminating weeding and the erosion which results from soil disturbances, for without tillage coffee feeding roots form a dense mat close to the surface, holding the soil in place. Further soil temperature under the branch shade is reduced by as much as 10° C. at 2 inches below the surface which probably retards the rate of oxidation of organic matter, usually so rapid in the tropics. Pruning is hardly practised. Instead the seedling tree when 2-3 ft. high is bent over and attached to the ground. Other shoots then arise from near ground level and these in turn are bent outwards and fastened down in different directions. The weight of the crop pulls the branches open and the shoots which thereupon arise are also fastened down. This method reduces the cost of cultivation greatly and the author considers it worth a trial on European estates. A few sub-varieties are briefly described under their native names. Selection in Robusta coffee is usually for vigour, yield and size of bean, the latter character being of some importance, as Robusta is sold largely on appearance. Quality of coffee appears to depend more on soil and methods of manufacture than on genetical factors. In first selections trees at least ten years old are preferred as seed parents because the characters are by then fairly fixed, but in selecting from succeeding generations selection must be based on record of crop, size of bean and general appearance of the tree, since time cannot be spared for the trees to develop fully. The possession of stout branched primaries is considered a good vegetative indication of quality. Self-pollination tests resulted in from 45%-6% sets.

Similar trials in Java are reported to have produced only 0·5% set. This self-fertility seems to be characteristic of Nganda trees. It will be interesting to see whether the Javan Robusta when grown in Uganda, one of its original homes, will be more self-fertile than in the Dutch East Indies.

692. McClelland, T. L. 633.73-1.543.1

Coffee shade in Kenya.

East Afr. agric. J., 1935, **1** : 107-18.

The characteristics desirable in a shade tree for coffee are deep rooting so as to lessen competition with the coffee for soil moisture, wide branch spread but light foliage, the loppings and leaves to form a good mulch, toughness to resist wind, and comparative immunity to pests and diseases. Varieties that fulfil all these conditions are few. In addition to the benefit of increased humus and the shelter afforded from the weather, shade is of especial benefit to coffee in that, by equalizing the temperature, it induces a uniform growth and eliminates much handling and centreing, prevents overbearing and consequently reduces biennial bearing, controls "hot and cold" disease and Elgon dieback. A list of 44 shade trees which have been tried with coffee is given with notes as to their degree of suitability. It by no means follows that a shade tree suitable in one district will be found so in another. It is emphasized that the regulation of the shade as the shade trees develop is essential, and that the amount of shade necessary for the best results should be a matter of individual study on each estate. In planting shade between coffee it is suggested that it is better to plant the tree close to a coffee plant and actually to remove the latter when it begins to suffer from the proximity of the tree rather than to plant between the coffee plants and thus risk having four poor plants instead of one. In view of the present uncertainty as to the most suitable trees, a system of mixed shading is advised. The planting should err on the side of overcrowding, since it is easier to remove than to establish shade and the probabilities are that some of the varieties will prove unsuitable. In some districts, where the rainfall is not sufficient to support both coffee and shade trees, artificial shade has been tried with success. This is of three types, *complete shade* over the whole plantation ; *belt shade* along the rows, with spaces between the rows ; *individual shade* over each tree. Details and diagrams are given of the construction of belt shade, a type which the author considers to be the most satisfactory. It consists essentially of slats of sisal poles or bamboo laid across a framework of two taut wires running longitudinally, the slats being kept in place by a third longitudinal wire running centrally over the top of them. The longitudinal wires are attached at the ends to cross wires which are fastened to corner posts anchored by guy wires to steel railway sleepers. The cost for Kenya is estimated at 10 pounds per acre with an annual depreciation of 10 per cent.

693. Sturdy, D. 633.73-1.543.1

Observations on coffee under artificial shade at Selian Coffee Estate, Arusha, 1931-5.

East Afr. agric. J., 1935, **1** : 135-9.

Experiments lasting 4 years on the artificial shading of coffee, 2 years old at the start, led to the following observations. Artificial shade almost completely controlled yellowing and dieback. The habit of growth altered. Main stem internodal length and branch internodal length were increased by 22·9 and 21·6% respectively. The average number of leaves per branch was reduced 31·4%, the average area of any one leaf was increased 83·3% and the total leaf area per branch was increased 20·5%. Thrips (*Physothrips xanthoceros* Hood) attack seemed less severe on shade coffee, but coffee leaf disease (*Hemileia vastatrix*) was more extensive, though the attack was mild. Pest and disease incidence were only recorded in one year each, 1931 and 1933 respectively. As regards yield and quality shaded coffee produced 18-20 cherries to the ounce and therefore possibly a larger bean than unshaded coffee, which produced 20-25 cherries to the ounce. Reports from the London brokers indicate a slight advantage in quality in favour of the shaded sample. Owing to tree variation and other factors it is not claimed that these results will bear statistical examination, but they are thought to be of sufficient interest to be recorded.

694. Kaden, O. F. 633.73-1.542
Erfahrungen im Kaffeeschnitt Westafrikas. II.* (**Pruning coffee in West Africa. II.**)
Tropenpflanzer, 1935, **38** : 108-12.
In a previous article the author dealt with a multiple stem method of training and pruning robusta and arabica coffee. He now shows how the same principles should be observed in dealing with *C. liberica* and *C. excelsa*. Noticing the very poor condition of liberica trees pruned by old methods, their extreme susceptibility to leaf fall diseases and root eelworm and to various root infections he found that drainage and proper cultivation helped up to a point. But it was not till he had seen methods of pruning in Surinam that he attempted to apply them to liberica coffee in West Africa. The attempt was entirely successful. The principle of multiple stem pruning can be just as easily observed in both liberica and excelsa coffee. It must be remembered, however, that both of these have very hard wood and may develop main stems several metres in height. On the other hand they can stand hard usage and need little attention. The best plan is to aim at two to three stems. Bending over for the provision of multiple stems is unnecessary, as a number of water shoots always arise from the main stem. Those issuing near ground level should be used and should be forcibly bent at an early stage in a direction opposite to their normal growth in order to ensure better light conditions and fruit formation. This can be managed by the help of wooden wedges between the stems. The tall main stems should be cut down so as not to exceed 3 to 4 m. Other operations, including secondary pruning, should be carried out as described in the previous article and abstract.*

695. Thorold, C. A. 633.73-2.19
Progress report on Elgon dieback of coffee.
East Afr. agric. J., 1935, **1** : 225-8, bibl. 3.
The author produces data in support of the view that Elgon dieback of coffee is a physiological disease. It is almost non-existent under natural shade, and tests are being made to see if this holds true also under artificial shading. In the Elgon district there is a prejudice against shaded coffee. It is, therefore, necessary to prove that shaded coffee is no more susceptible to disease and is more economic than unshaded coffee. Experiments to decide this point have been laid down, but useful results will not be available under 5-10 years. Varietal resistance to Elgon dieback does exist, a copper-tip type of French Mission being notable in this respect. There is, however, a high proportion of elephant bean in samples from this type of tree. Notes are given on a long series of experiments in being or projected dealing with this dieback disease in Kenya.

696. Morstatt, H. 633.73-2.76
Kaffee- Schädlinge und -Krankheiten Afrikas. (**Pests and diseases of coffee in Africa.**)
Tropenpflanzer, 1935, **38** : 413-31.
The author states that his purpose here is to give an account only of the essential features which should be observed with regard to particular pests and the best methods of initiating and carrying out control methods. He published a book on coffee pest and disease control in East Africa in 1912 and in the present articles he proposes apparently to bring the facts there stated up to date. In these particular articles the following pests are dealt with :—*Anthores leuconotus* (white coffee borer), *Bixadus sierricola*, *Dirphya* (*Nitocris*) *usambica* (yellow borer), *Dirphya* (*Nitocris*) *princeps* (yellow headed coffee borer). Various other beetles including the black coffee borer beetles belonging to the family *Bostrychidae* are dealt with briefly.

697. Trinidad and Tobago. 633.74
Cocoa relief measures.
Circ. W. Ind. Comm., Lond., 1935, **50** : 491-5.
The following is a summary of the proposals for the relief of the cocoa industry of Trinidad and Tobago which have been unanimously approved by the Legislative Council. Assistance is to

* See *Ibid.*, 1934, 37 : 367, *H.A.*, 1935, 5 : 1 : 124.

be given to the cocoa industry in the form of a free grant over a period of four years. The grants are to be administered by a Committee and to be based on production, at the rate of 1 cent per lb. not exceeding a maximum of 5 dollars per acre, subject to certain adjustments and provisions. Estates will be divided into 3 groups: A 1-10 acres, B 11-50 acres, C over 50 acres. From estates over 10 acres receiving a grant a specific programme of work will be demanded. Grants will not be made to large estates which have been grossly neglected or abandoned. Nurseries of high yielding strains of cacao are to be established for the distribution of plants at a small charge, which will be deducted from the grant.

698. Kaden, O. F. 633.74
Ordnung der Kakaobaumtypen für Zücht- und Bewertungszwecke. (**A classification of cacao tree for breeding and evaluation purposes.**)
Tropenpflanzer, 1935, **38** : 367-78, bibl. 10.

A classification of cacao tree types has been made to accord with the needs of modern planting and commerce, the old so-called cacao species not being found suitable. Only 4 species are retained, namely :—*Theobroma cacao* L., *T. pentagona* Bern, *T. leiocarpa* Bern and *T. sphaerocarpa* Chev. The most important species, *T. cacao*, includes a vast number of modifications due to habitat in different parts of the world. The other " species " have arisen from *T. cacao* by mutation. Specimens of all four species may be appropriately grouped into qualities which are designated as Edelkakao (special cacao) and Konsumkakao (ordinary cacao). Quality is determined by chemical and physical analysis of the cacao seeds or beans. Quality depends on the tannin content, the higher the tannin the lower being the quality. The " ordinary " quality can also be subdivided according to tannin content. A correlation has been established between qualities and shape of cacao fruits and this is a great simplification of the old cacao classification systems. In conclusion the author deals with true hybrids between " ordinary " and " special " quality cacao, and these in his opinion offer the brightest hopes for the future of cacao breeding.

699. Burchardt, H. 633.74-1.541.5
Das Veredeln von Kakao. (**Grafting and budding cacao.**)
Tropenpflanzer, 1935, **38** : 239-45.

The author gives an account of the successful change over which is being made by the New Guinea Company in its cacao plantations at Bococo, Fernando Po, from forastero to criollo cacao by budding the former with the latter. The oldest existing trees so worked 4 years ago are now healthy, strong growing, and well furnished with fruit. So far from feeling any ill effects, the scions appear to have benefited from being worked on the stronger and hardier forastero type. The method of budding which has been particularly successful in the case of 3-year-old trees standing about 1½ metres high and with a diameter of 4 cm. is given below. Such a size is particularly suitable for a good take. Only such scion wood is used as has just achieved complete ripeness at 9 months. The so-called water shoots which provide it have their buds on spirals. Their ripeness can be determined from the bark, which should have exchanged the down of youth for a rather rough and split condition. The time for budding depends on the weather, the best of all being an overcast but fine day following considerable rain. The operation is as follows :—a piece of bark some 6 to 8 cm. long is removed with a sharp knife from the shady side of the stem of the rootstock, about 20 cm. above ground level. During the passage of the knife through the cambial layer the separated bark shield should be pressed in tightly with the thumb. This prevents exposure of the delicate cambial layer to light and air. A bud is then cut of corresponding size, particular care being given to preserving the heart intact. The flap of bark is quickly removed and the bud applied immediately. It is bound with raffia and the edges of the wound covered with liquid grafting wax. In the moist tropical atmosphere a crust will soon form to prevent the entry of air and water. With the help of two natives it was found possible to do 80 to 100 buds in 2 hours. If after 2 to 3 weeks union has taken place, the forastero stem is bent down to the ground where it is fastened by pegs or weighting, care being taken that the bud comes on the outside of the bend. In some cases the stem is too strong to bend right to the ground, but it should be so arranged that the lowest part

of the stem is at least on a slant. The irritation caused by the bending causes an inflow of sap and nutrients to the injured spot. These stimulate all the dormant eyes including the new one into growth. The resulting forastero growths are removed. When the criollo shoot is 20 cm. long the top of the rootstock is removed, leaving only a 30 cm. stump to which the young shoot is bound until about 6 months from budding, when support should be no longer necessary and the stump can be entirely removed. This is best done with a saw and finished off with a pruning knife, the surface being then covered with wax. Such trees have so far begun to bear fruit at latest 2 years after budding. The same operation has been successfully carried out by the author in young forastero nursery beds. This offers the advantage of easy supervision after budding, but a distinct disadvantage in the greater care necessary in transplanting the nursery worked trees. Where it is decided to work trees in the nursery, the rows should be 35 cm. apart and 20 cm. from plant to plant within the row. The seedling forasteros are ready for grafting at 18 months when about a forefinger thick. The best time for budding in Fernando Po is towards the end of what is called the short rainy period, i.e. May to June, in which case the trees should be ready for transplanting 6 to 8 weeks later in August during the true rainy season. The technique adopted in planting out is as follows :—The leaves up to those immediately surrounding the terminal bud are removed. The roots are dipped into a loamy mulch and the trees are planted out in holes previously prepared. The author has sometimes left the worked trees standing a further year in the nursery before transplanting, in which case it has been necessary to cut the scion back to $\frac{1}{3}$ of its length. All things considered he prefers budding in the permanent plantation. For budding older, i.e. 5- or 6-year-old trees, the T cut method is recommended and has been successfully used at times when the sap is flowing strongly and the bark comes away well. At whatever period and wherever carried out, in the plantation just as much as in the nursery, it is essential to provide shade for the buds. For this in Fernando Po the Jamaica banana has proved very useful.

700. Hardy, F., and others. 631.8 : 634.323 + 633.74

Leaf analysis as a means of diagnosing nutrient requirements of tropical crops.

J. agric. Sci., 1935, **25** : 610-27, bibl. 9.

This paper describes an investigation in Trinidad into the nutrient relationships that obtain between cacao and grapefruit trees and the soil in which they are growing, as gauged by means of chemical analysis of representative leaf material. For convenience the results may be examined in three distinct stages. In the first comparisons are drawn between the leaf compositions of the two crops, two soils being represented in each case, making four in all. These four soils are fairly similar in their physical attributes and their nutrient status, except that one cacao soil and one grapefruit soil possess a higher lime status than the other two. Nevertheless wide differences were found in the composition of the leaf-ash of the two types of tree. For instance the lime content of the leaf ash of cacao was very much less than that of grapefruit both for the two soils with the lower lime status and for the two with the higher lime status. The potash content in cacao was correspondingly greater. The grapefruit tree is therefore considered to be markedly calcicolous, and even when grown in soil very deficient in available lime it seems to be able to concentrate a considerable amount of lime in its leaves. The second stage involved a method of utilizing the leaf analytical data for the purpose of assessing the nutrient requirements of the trees and the nutrient status of the soil. This was done by the employment of standards of comparison consisting of " ideal " trees. In the case of cacao, a healthy tree of known high yielding capacity was used, but in the case of grapefruit the recent establishment of the industry precluded the use of a local standard, and so recourse was made to the accepted standard for Californian citrus trees. These comparisons made, the third and final stage involved a study of the effects of manurial treatments in reducing deficiencies based on comparisons with the standard trees, and secondly a comparative study of the growth development of the trees as related to leaf composition when modified by these manurial treatments. Manurial trials of both crops have now been in progress for several years. In the case of cacao statistical comparison has been made between yield data and data for the chemical composition of leaf material, but in the case of grapefruit no yield data are as yet available, so that comparisons

had to be restricted to growth increment data and leaf composition. The results to date of these manurial trials are described and tabulated in detail, and in particular, in making the comparisons the nutrient ratios of the different components of the leaf ash (phosphate, potash, lime and magnesia), and of leaf nitrogen were found to be useful. The reliability of using leaf analysis as a means of diagnosing nutrient deficiencies or excesses in cacao and grapefruit soils is held to be established, and it is considered that the method may prove of value as an ecological instrument for the study of crop production as a whole. Emphasis is laid, however, upon the importance of first providing reliable standards of comparison.

701. Venkata Rao, M. G., and Gopalaiyengar, K. 633.814-2.8
Studies in spike diseases of sandal. Methods of inoculation and variation of results under different methods.
Bull. Mysore Sandal Spike Investigation Committee, **5**, 1934, pp. 13, bibl. 12.
The virus causing the spike disease of sandal was transmitted in every case in which twig grafts were made. In other types of graft, in which organic connexions were formed, namely buds, patch bark-grafts, ring bark-grafts, and leaf insertions, the disease only developed in a certain proportion of cases ranging from 17% to 63%. In the case of ring bark-grafts the highest percentage of transmission, was found in plants grafted in May and June, which is the period of greatest vegetative activity, and the lowest in October. With young saplings 2 or 3 feet high the disease was not found to be generally transmitted through the haustoria, because the young living roots of adjacent sandal trees, which these attack, die once the plants become spiked. Severe pruning of sandal plants appears to weaken their resistance to attack.

702. Venkata Rao, M. G. 633.814-2.8
The rôle of undergrowth in the spread of spike disease of sandal.
Bull. Mysore Sandal Spike Investigation Series, **6**, 1934, pp. 18, bibl. 13.
The incidence of spike disease of sandal is highest in scrub and lowest in cultivated areas. The rapid spread under scrub jungle conditions does not appear to depend on the presence of any particular plant. The lantana bush has often been suspected, but no decrease in the rate of spread has been found when it is absent. Certain other likely plants tested do not appear to be alternate hosts, and it is therefore suggested that undergrowth may afford a suitable habitat for an unknown insect vector. Pollen and seed from partially spiked trees proved negative as possible sources of infection. The transmission of the disease in some manner above ground has been shown to occur in an experiment, in which healthy plants in pots were placed in an infected area and contracted the disease. That the minimum incubation period is less than 9 months has been shown by young plants of that age becoming spiked. There are indications that shade may have a beneficial effect upon plants exposed to infection. The spread of the disease towards the south has been much more rapid than towards the north, and whereas the whole southern sandal area of India is now affected there are still some of the richest sandal tracts to the north of Mysore, which are entirely free.

703. Deshpande, R. B. 633.842
Studies in Indian chillies (4). Inheritance of pungency in *Capsicum annuum* L.
Ind. J. agric. Sci., 1935, **5** : 513-6, bibl. 4.
Two Pusa types of chillies isolated in 1928 and maintained pure since, the one a pungent and the other a non-pungent type, were used as parents in these breeding experiments. The genetic results show that pungency is definitely a heritable character though modified by environmental conditions, and that it is a simple monogenic character dominant to non-pungency. Thus in the F_2 generation a segregation on a 3 : 1 basis took place, and again in the F_3 in 15 cultures from pungent fruited plants, whilst 5 cultures from non-pungent fruited plants proved, as was expected, pure non-pungent types. The same arrangement has been found for the character of the calyx enclosing or not enclosing the fruit-base, the latter being dominant. Segregation on a basis of this character has, however, been found to be quite independent of that based on pungency.

704. Lall, G. 633.85 : 581.192

Some observations on the essential oil content of Rosha grass (*Cymbopogon Martini* var. *Motia*).

Ind. J. agric. Sci., 1935, **5** : 415-27.

Rosha grass yields an essential oil known as Palmarosa oil or Rusa oil, used in the manufacture of certain soaps and perfumes. The largest amount of oil throughout the season is yielded by the leaves. It averages 1·22 to 1·30 per cent. of the dry weight in September rising to a maximum of 1·39 per cent. in mid-October and thereafter declining as flowering occurs to a minimum of 0·77 per cent. in March. If there is frost, the decline will be greater still, and cutting and stacking the grass before frost does not arrest the decline of the oil content. The best quality oil is obtained from the leaves, a slightly inferior quality from the stalks and flower heads, and a poor quality from stacked grass. Chemical analysis of the oil is given. The material was obtained from a ½ acre plot planted four years previously near Jaranwala, Punjab.

705. Deger, E. 633.88

Intensivierung der Chinakultur in Mittelamerika. (**Increased cinchona growing in Central America.**)

Tropenpflanzer, 1935, **38** : 24-8.

Cinchona has been under trial in Guatemala for the last 10 years under widely differing environmental conditions. The varieties grown have been extremely mixed and have included numerous *succirubra* and *ledgeriana* plants, the yield of which has varied remarkably. The author tabulates his analyses of the more important samples submitted to him, noting at the same time the altitude and place of growth, the variety and colour, the total alkaloid content and the quinine sulphate content. He considers that there is a future for cinchona culture in Guatemala, but only provided particularly good seed is imported in the first place. He proceeds to give a brief account of the work in Tanganyika before the war of 1914/18. In 1903 a small quantity of seeds from Java hybrids possessing a high quinine content was imported and sown mainly at an altitude of about 1,000 m. A few months later 50 grammes of seed of a particularly good *ledgeriana* strain and another 25 grammes of hybrid seed was also received from Java. In the following year seed of *C. robusta** was also received from Java. The seed was sown and the resulting trees were watched carefully. Working *C. ledgeriana* on *C. succirubra* was found successful. In 1906 the first 20 kg. of bark were tested at Stuttgart and showed by analysis 6·47-6·80% of quinine sulphate [which is higher than that given by any of the Guatemalan plants recently listed.—Ed.]. The various trees were treated on forestry lines and their bark submitted to analysis up till 1914. It became evident that *C. ledgeriana* trees grew more slowly than *C. succirubra*, *C. robusta* and the hybrids and that it was the hybrids that yield the bark richest in quinine.

706. Kheswalla, K. F. 633.88-2.411

Seedling blight of *Cinchona Ledgeriana* Moens caused by *Phytophthora palmivora* Butl. in the Darjeeling district.

Ind. J. agric. Sci., 1935, **5** : 485-95, bibl. 19.

The disease described here was first observed in the Darjeeling district in 1928 in *Cinchona* seed-beds, where it was causing considerable loss. The first symptom of attack is discoloration of the collar tissues of the seedling. The affected area gradually spreads until the cotyledons are reached, and these then become limp. The leaves gradually become yellow, curl inwards, and occasionally are shed. Rotting of the stem follows, and when this reaches the vascular regions the seedlings collapse from above this point and die. The fungus isolated was found to be a *Phytophthora*, and by means of morphological comparisons with various species and by cross-inoculation tests it has been identified as a strain of *P. palmivora*. The optimum temperature for its development has also been established as about 24° C. (75·2° F.). Above and below this temperature the growth decreases, and at 35° C. (95° F.) ceases altogether.

* Regarded as a *C. succirubra* × *C. officinalis* cross.

707. Voelcker, O. S. 633.88
Cotyledon colour in kola.
Trop. Agriculture, Trin., 1935, **12** : 231-4, bibl. 7.

The most important commercial kola, *Cola nitida* A. Chev., is described. The colour of the nuts, which are composed of two cotyledons, varies from white through shades of pink to dark red. Of these colours the white or lighter pink shades are the most sought after by native buyers. The reason for this is uncertain, but the result is an enhancement of price of these colours. Nuts of different colour may be found on the same tree even, it is said, within the same fruit follicle, and the proportion of colours on the same tree is not constant from year to year. At Ibadan 3 plots of kola, situated some distance apart, grown from white, pink and red nuts respectively were fruiting. This made investigation possible. Individual tree records of the pink and the white plots had been taken since 1931. Self-pollination of trees in the white plot in 1933 resulted in an entirely white crop. Self-incompatibility was noted in 3 of the trees. In 1934 pollination of flowers from the white plot with pollen from the red plots resulted in 11 white, 94 pink, 721 red ; reciprocal crosses, white on red, produced no white, 60 pink and 149 red. These data point, it is thought, to the absence of colour in the white seeds being a recessive character, while the incidence of colour is complex and to be attributed to several genes whose number determine colour density. This hypothesis bears out Wellensiek's conclusions* in his investigation of cotyledon colour in cacao. Cross pollination occurs naturally in the field. The carrying agent of the pollen is at present unknown. A distance of 300 ft. between trees is not sufficient to ensure isolation.

708. Mann, C. E. T. 633.912-1.521
Recent progress in the selection of planting material of *Hevea*.
J. Rubb. Res. Inst. Malaya, 1935, **6** : 21-34.

Evidence for and against the use of seedlings from budded trees of well known proved clones as planting material in place of budded clonal trees is discussed. Hand pollination of high yielding parents produced seedlings whose yield was outstandingly superior to trees from unselected seed. Besides the character of yield the secondary characters of vigour, bark quality, resistance to diseases and mechanical damage can also be transmitted to the seedlings, though this is by no means invariable. Seedlings obtained from naturally pollinated, high yielding clones growing in isolated gardens equalled in yield that from the hand pollinated crosses. It appears, however, from all the work done to date that, while by carefully controlled crossing of selected parents the resultant seedlings are capable of yielding twice as much as unselected seedlings and approaching the yield of buddings of good proved clones, the highest yield level of the best seedling family does not reach that of the best proved clones. The suggestion is examined that by planting buddings of, say, two high yielding clones in isolation and allowing free crossing between them results may be obtained equal to those from carefully raised hand pollinated families. The danger that the flowering times may not correspond is pointed out. If the number of parents be increased, the really valuable clone may produce its flowers out of season and set very little seed, while other less valuable parents may seed freely. Variations of time of flowering of the different parents in different years may result in a considerable variation of the value of the successive seedlings. Certain clones such as 157 and A.44 have given seedlings of the highest average quality in whatever combination they have occurred, and the suggestion is made that clones such as these should always serve as seed parents while other highest yielding clones should serve as pollinators only. In this case seed would have to be collected from the known superior parents. A point emphasized in conclusion is the individual variability even in seedlings of one family. Some individuals may be of little more value than the poorest unselected seedlings, while others may be excellent and eventually prove more valuable than any clones available at present.

* Der erfelijkheid van zaadlobkleur bij cacao als basis voor qualiteitsselectie. *Arch. Koffiecult. Ned.-Ind.*, 1931, 5 : 217-33, *H.A.*, 1932, 2 : 1 : 71. (Genetics of cotyledon colour in cacao as a basis of selection for quality.)

709. Murray, R. K. S. 633.912-1.541.11
Ceylon clones. III.
Quart. Circ. Rubb. Res. Scheme (Ceylon), 1935, **12** : 25-32.
This is the third of a series of annual reports on the test-tapping of Ceylon *Hevea* clones. Eighty-five clones represented by 826 trees were recorded. Four new clones of promise have been added to the lists.

710. Gunnery, H. 633.912 : 1.55 : 581.4
Yield prediction in *Hevea*.
J. Rubb. Res. Inst. Malaya, 1935, **6** : 8-20, bibl. 1.
This is a study of sieve-tube structure in relation to latex yield. The anatomical structure of the bark and the latex system is described and two extreme types of sieve-tube are shown to occur. Sieve-tubes of small diameter are associated with narrow bore latex vessels in trees with low latex-yielding capacity. Sieve-tubes of large diameter are associated with latex vessels of large bore, and all trees of high-yielding capacity which have been studied in the investigation reported here have sieve-tubes and latex vessels of this type The presence of a constant type of sieve-tube in all parts of the tree and the demonstration of the advanced development of the sieve-tubes in the bark of one-year-old stems permits of immediate qualitative analysis of a mixed population of young seedlings and suggests a means whereby low-yielding individuals may be eliminated at a very early stage. Investigations in the past have endeavoured to establish a correlation between yield and number of latex vessel rings. The present investigation shows, however, that the number of additional latex vessel rings required in a typical low yielder to compensate for the superior size and development of the latex vessel complement of a high yielder is unlikely to be found. Certain trees may have a definite superiority in yield capacity which may be quite independent of the relative number of latex vessel rows.

711. Cramer, P. J. S. 633.912-1.521
Improved rubber seeds.
Trop. Agriculturist, 1935, **85** : 3-9.
A paper by J. S. Vollema published in *Bergcultures*, 1935, p. 40 [now unobtainable by public.—Ed.] entitled " The latest advances in relation to *Hevea* selection on the West Java Experiment Station ", is discussed and criticized. A clonal planting of 160-200 budded plants per acre, thinned selectively in the 15th year to 90-100 trees, should average 440 lb. per acre in the 6th year increasing to 1,760 lb. per acre in the 15th year. The value of clonal seedlings is examined. Clonal seeds may be divided into 4 classes. A. Seeds from fields in which the poorer yielders have been removed. B. Seeds from high yielders with an unknown pollen parent. C. Clonal seeds from a high yielding clone in a mixed block of high yielders of different clones. D. " Legitimate seeds " of which the parents are known, produced by artificial pollination or from the centre of a monoclone or at most two-clone block. Class A seedlings have in their 11th year produced nearly 660 lb. per acre. Class B has been shown by extensive statistical data to give an improvement in yield of rubber of 30% and in the 11th year have produced 968 lb. per acre. In Class C the yield has doubled that of ordinary seedlings, and has amounted to 431 lb. per acre in the 5th year. Class D produced results equal to those of good medium clones, but, whereas the variability of yield between the highest and lowest individuals of a clonal planting is $2\frac{1}{3}$ times, between these clonal seedlings it was nearly 5 times. Vollema thinks that eventually plantations established from the new clonal seedlings will produce as highly as clonal plantations, especially as their greater variation and close planting will permit of profitable selective thinning. With Vollema's recommendation that seed producing fields should be laid down consisting of a mixture of 5 clonal varieties densely planted and systematically mixed Cramer does not agree. He considers that seedlings from monoclonal plantings should be used on the ground that only thus can all the hereditary characters of one batch of seedlings be nearly certainly reproduced in later seedlings from the same mother tree. A mixture of even two clones renders this impossible, since it is always uncertain whether the desirable seedlings were self- or cross-pollinated. There is, too, still scope for selection between the seedlings of a

monoclonal plantation. In the plantations controlled by Cramer selection of monoclonal seedlings begins in the first year for vigour of growth and latex flow. Only 3 or 4 per cent. of the millions sown are retained, and there is a further selective thinning out when the trees are 3 years old and can be submitted to Mann's tapping test.

712. Eaton, B. J. 633.912-1.874
The use of natural covers on rubber estates.
J. Rubb. Res. Inst. Malaya, 1935, **6** : 62-71, bibl. 3.

In this paper the author replies to a number of statements and criticisms which have appeared in the press during the past two years on the so-called " forestry methods " of *Hevea* cultivation, that is to say those methods in which the practice of clean weeding is abandoned in favour of a natural though possibly controlled undergrowth. He points out that the Rubber Research Institute is fully alive to the importance of the problem and has long since given its support to the practical application of the procedure, but that at this early stage it is impossible to make any general recommendations. In conclusion the practical advantages of the system as outlined in *Plant Manual* No. 6 issued by the Rubber Research Institute are restated. These are (a) retardation or prevention of soil erosion, (b) prevention of excessive run-off or rainfall so that more water is absorbed by the soil, (c) shading of the soil to maintain the temperature below that at which excessive loss of humus occurs owing to oxidation, (d) improvement of the surface soil layers in respect of humus content from the litter formed by continual decay of the natural covers, and (e) improvement of the percolating and water absorbing capacity of the soil.

713. Beeley, F. 633.912-2.73
Hevea thrips.
J. Rubb. Res. Inst. Malaya, 1935, **6** : 58-61, bibl. 1.

A new thysanopterous pest of *Hevea* in Malaya is described and provisionally called Hevea thrips. The insect causes severe leaf-fall but may be controlled by insecticidal dusts applied by means of a motor duster.

714. Beckett, R. E., and Stitt, R. S. 633.913
The desert milkweed (*Asclepias subulata*) as a possible source of rubber.
Tech. Bull. U.S. Dep. Agric., **472**, 1935, pp. 20, bibl. 13.

Asclepias subulata Decaisne is a desert milkweed from the dry areas of South-western U.S.A. and parts of Mexico. It is a perennial herb with a rubber content, which appears to range from 0·5 to 6·0%, the mean of plants examined being 2·86%. Seeds from selected wild plants have been grown under cultivation at Bard, California, and at 3 or 4 years old when the plants reached their greatest size they had a maximum rubber content of 5%. Harvesting should apparently be done at some time between January and April when rapid ratooning will follow. Plants harvested in July ratooned slowly, and those harvested in October either died altogether or recovered very slowly. Yields equal to or exceeding the original yields may be obtained from the ratoons after 2½ to 3 years. In spacing trials plants left unthinned in rows 1 foot apart produced 212 lb. rubber to the acre at 2 years old as compared with 71 lb. per acre from plants thinned to 3 feet apart in rows 4 feet apart. In storage tests stems kept in paper bags in a dry, partially darkened room showed no appreciable loss of the rubber content after 2 years, and a loss of only about one-fourth after 4½ years. Stems left exposed to the weather on the other hand lost nearly all their rubber within 3 months. The authors conclude with a brief account of the difficulties associated with breeding work owing to self-sterility, and with notes on three insect pests, none of which is of much importance, and all of which are easily controlled.

715. Parsons, T. H. 634.1/8
Summary of progress on fruit production in Ceylon.
Trop. Agriculturist, 1935, **85** : 78-101.

It is stated that the adoption of budding or grafting methods for fruits in Ceylon is a recent innovation, though inarching was occasionally practised with some fruits. The first budding on a large scale of an economic crop was with rubber in 1921. Since then a number of fruits

have been successfully worked, and stages of this work are described year by year. These cannot be given in an abstract, but the following points of interest may be quoted. The cherimoya (*Annona Cherimola* Mill.) buds easily on the soursop (*Annona muricata* L) and succeeds at elevations of 2,000 ft. and over. Stock trials with grapefruit scions laid down in 1931 show sour orange to be the leading stock for growth and vigour at the present time in Peradeniya with *Citrus* sp. 4/5 a good second. Grapefruit on American shaddock (a hybrid with lemon parentage) is losing vigour, on grapefruit is variable and on nataran (nearly related to, if not identical with, the citron, *C. medica* L.) there is a definite dwarfing. All the stocks were from seed except the nataran, which was raised from cuttings. The dwarfing tendency is here ascribed to that fact. The nataran budded stock requires careful transplanting or many losses will occur. Mangoes are successfully cleft grafted on seedling stocks 3 months old. Sapodilla (*Achras Zapota* L.) grafted on mee (*Bassia longifolia* L.) made one good flush and then ceased further growth, eventually dying.

716. Ahmed, M. S. 634.412 : 581.162.3

Pollination and fertilization of *Annona squamosa* Linn. under dry climatic conditions.

Commun. 11 ème Congr. Int. Hort. (Rome), 1935, pp. 7.

Cultivation of *Annona squamosa* Linn. (sugar apple) in Egypt is difficult in the newly reclaimed sandy districts owing to the driest and hottest season of the year coinciding with and adversely affecting fruit setting. Owing to maturation of anthers and stigmas at different times self-pollination of individual flowers is impossible. Certain *Coccinellidae* visit the flowers in search of mealy bugs and aphids and the cleaner plantations always seem less fertile than those in which mealy bugs abound. The action of the heat in the drier districts appears to be the curtailment of the normal functioning period of the essential parts owing to rapid maturation, and its lethal effect on the pollen grains, which are carried about on insect bodies. In the matter of hand pollination the operator is assisted by the fact that the flowering period extends over two months and that only twenty to thirty suitable flowers will probably be open at the same time on a tree. Mother flowers are chosen from among the more sheltered and those close to 1-year or older wood. The pollen is taken from exposed flowers and those on wood of current growth. The flowers are picked overnight before any discolouration of the petals occurs and are kept in paper bags. By early morning the flower parts will be easily detachable and the stamens holding the pollen will fall off. The stigmas are receptive when the petals are still attached at their distal ends, but can be separated from each other by a slight pressure. Pollen is inserted with a small camel hair brush and the petals by reclosing provide a shelter and humidity which aid the pollen germination and subsequent fertilization. A man and boy can pollinate 50-60 trees a day and each tree is dealt with about 9 times in the course of a season. The trees are self-fertile. Pollen applied by hand from neighbouring flowers on the same tree proved as effective as that brought from other trees. Attempts to keep the stigmas receptive until the shedding of the pollen have failed. Attempts to produce a fruit with few seeds by selfing were unsuccessful.

717. Plummer, C. C., and Stone, W. E. 632.77 : 634.441

The disposal by burial of fruit infested with larvae of the Mexican fruit fly.

Circ. U.S. Dep. Agric., **349**, 1935, pp. 15, bibl. in text.

In the first of two experiments described here mangoes infested with larvae of the Mexican fruit fly, *Anastrepha ludens* Loew, were buried in pits ranging from 18″ to 40″ deep, measurements being recorded in all cases from the tops of the fruits. In one series the soil, which was very dry and hard, was packed down with a light wooden tamper, and in a second series it was left unpacked. Wooden cages covered with 18-mesh screen wire were placed over the pits. The emergence of adults was recorded daily, and finally when no further emergence was considered possible the soil in most of the pits was removed inch by inch and numbers and conditions of puparia and adults recorded. In the unpacked series adults emerged from pits 18″ and 27″ deep, but none emerged from any of the pits in the packed series. The subsequent examination of

the unpacked soil covering the mangoes showed that some of the larvae had moved for upwards of 20 inches towards the surface before pupating, and further that some of the adults which had been counted in the cages must have come from puparia at least 22 inches below the surface. From this the authors conclude that if soil is not packed the pits should be at least 4 feet deep to allow for the maximum distances which each insect, first as larva and later as adult, may travel. On the other hand where packing is done 18 inches would appear to be sufficient. In the second experiment carried out during the following year, sand both moistened and dry was found to be effective when packed down to give an 18″ covering over the fruit, but owing to the compact state into which it settles the moistened sand was considered to be the better of the two. It is believed that the results of these experiments will hold good for citrus fruits as well as mangoes.

718. Stephens, S. E. 634.571

The litchi.

Qd. agric. J., 1935, **44** : 191-4.

The article is concerned with the possibility of establishing the litchi (*Nephelium Litchi* Camb.) as a commercial fruit in Queensland. Necessary environmental conditions for a successful litchi orchard are plentiful soil moisture, a rich alluvial loamy soil, humid atmosphere, freedom from frost. The humidity of the atmosphere appears to be of minor importance, provided soil moisture is adequate. Cultivation is simple and consists chiefly in maintaining the soil in good condition. Heavy mulching with organic manures under the trees is advisable. No recommendations on the use of artificial manures are made in the absence of any experimental work. The tree bears on wood of the previous year and in the event of a heavy crop the wood growth is checked and no crop results in the year following. In the East, when the fruit is picked, the whole spray containing the fruit is picked together with a few inches of branch. This practice serves the purpose of pruning. At present in Queensland trees are raised either from seed or by marcotting. Both methods are open to serious objections, but of the two marcotting is the more satisfactory, as a fruiting tree can be produced in 3 years albeit with a weak root system. The need for more up-to-date methods of propagation is suggested. [A discussion of such methods will appear in the Technical Communication on the vegetative propagation of tropical fruit trees shortly to be issued by the Imperial Bureau of Fruit Production.—Ed.]

719. Pieris, W. V. D. 634.61

Studies on the coconut palm. II. On the relation between the weight of husked nuts and the weight of copra.

Trop. Agriculturist, 1935, **85** : 208-20, bibl. 3.

Part I appeared *Ibidem*, 1934, 82 : 75-94, *H.A.*, 4 : 2 : 284. In spite of the marked positive correlation between the number of nuts and the weight of copra per palm, the variability in the size of nuts from different palms and from varieties of the palm render an expression of yield by the number of nuts liable to an error too considerable for experimental work on small numbers. A second expression of yield, namely the weight of unhusked nuts compared with the weight of copra, gives a higher correlation, but the progressive desiccation of the husk in the storage heaps makes this method unsound. The third method of expressing yield is by means of the weight of the husked nut. This the author considers to be the least troublesome and the most accurate. A series of experiments was undertaken, and are described, to test this method. The percentage ratio between weight of copra and weight of husked nuts was found to be $33\frac{1}{3}$, i.e. the weight of copra equalled $\frac{1}{3}$ the weight of husked nuts. If this relation could be taken as standard, the labour and difficulties involved in field experiments with coconuts would be minimized. These difficulties are enumerated. As a result of further experiments the $33\frac{1}{3}\%$ ratio can be considered as approximately established assuming dead ripe nuts and optimum dry conditions. This ratio, which falls to 30% if a large number of immature nuts are present, may be considered with uniformly ripe nuts and average drying conditions as lying between 32% and 33%, and 32% should therefore be adopted as a percentage ratio between weight of copra and weight of husked nuts.

720. Joachim, A. W. R. 634.61

A uniformity trial with coconuts.

Trop. Agriculturist, 1935, **85** : 198-207, bibl. 9.

The data of a uniformity trial carried out at Wariyapola, Ceylon, in 1929-30, on a 360 tree block of coconuts over a period of a year were statistically examined by the method of analysis of variance. The experiment was originally intended to supply information as to the optimum plot size for field experiments with coconuts on the soil type of the station. The results, however, were not analysed at the time owing to the establishment of the Coconut Research Scheme. Now that the officers of the Scheme have been able to analyse statistically yield data from Lunuwila over a period of 2 years it was thought to be of interest to examine the Wariyapola data obtained on a lighter soil and under somewhat different climatic and crop conditions in order to see whether the optimum type of plot size would vary. It was found that in both districts with their different climatic and markedly heterogeneous soil conditions an 18-20 tree plot is the optimum for field experiments. The randomized block layout was used, and though the actual errors (45% coefficient of variation) are high compared with temperate crops, the marked variation in yield of individual coconut palms under estate conditions must be taken into consideration. A very similar range of errors was obtained by the Coconut Research Scheme at Lunuwila, although the average yields secured were about twice those at Wariyapola. The standard error for an 18 tree plot is about 14%. Six replications are required for treatment differences to be considered significant.

721. Paine, R. W. 634.61-278

The control of the coconut spike moth (*Tirathaba trichogramma* Meyr.) in Fiji.

Bull. Dep. Agric., Fiji, **18**, 1935, pp. 30, bibl. 7.

This paper provides an interesting historical account of attempts to control *Tirathaba trichogramma* by means of introducing parasites to Fiji. T. H. C. Taylor, who has co-operated with Paine in this work, has estimated that the total destruction of the coconut spike moth would be accompanied by an increased output of copra in Fiji of no less than 31·76%. After considerable trouble and a number of failures four parasites collected from species of *Tirathaba* have been introduced and now appear to be established. These are an egg parasite, *Telenomus tirathabae* Ferr., and the larval parasites *Apanteles tirathabae* Wilk., *Nemeritis palmaris* Wilk., and *Erycia basifulva* Bezzi. None of the types appears to have spread very rapidly, and what measure of control has so far been manifested seems to have been due largely to *Telenomus* and *Apanteles*. The other two were introduced and liberated successfully for the first time too recently to have had much effect. It is interesting that the number of female flowers destroyed by *Tirathaba* in 1934 was only 6% as compared with 21% in 1929, but on the other hand the number of young nuts remaining on spike IV was only increased by 1%, namely from 28% to 29%. The author sums up as follows:—" It would not be prudent to claim that the *Tirathaba* campaign has been a success on any evidence provided by these figures," and at a later point—" The disastrous decline in the market price of copra since 1929 has nullified any financial benefit which the campaign would otherwise have produced."

722. Berger, E. W. 632.752

The destructor scale. How to control it.

Press Bull. Fla. agric. Exp. Sta. **473**, 1935, pp. 2.

The preferred hosts of this tropical and subtropical scale insect, *Aspidiotus destructor*, are the coconut palm and avocado, but it has also been found on a number of other plants of economic importance such as the banana, mahogany, mango, papaya, rose and other palms, etc. The recommended control is spraying with an oil emulsion or miscible oil spray, white oils being the more suitable as less likely to cause injury. The proportion of oil to water will depend upon the plant to be treated. A maximum of $\frac{3}{4}$% is indicated for dormant avocados and of $\frac{2}{3}$% for summer spraying. Other plants may tolerate 1% or even 2%. Where the water is hard, the addition of 2 or 3 lb. laundry soap or fish oil soap per 100 gals. emulsion may be necessary.

These soaps may also be used by themselves at a rate of 1 lb. to 6 or 8 gals. water, but are not so effective as oil sprays. The best times to spray are when the crawlers are abundant or are just settling down to form the scale-like covering. It may be necessary to repeat this process some 3 or 4 weeks later. As a preliminary to spraying, the cutting out of severely infested parts, especially the leaves of palms, may be of value. These prunings may be left for some weeks on the ground, if the predaceous twice-stabbed ladybeetle is present, so as to allow the young of this insect to mature and escape. The control exerted by the ladybeetle is at best, however, subsidiary.

723. Bahgat, M. 634.62
A distinction between varieties of date palm.
Commun. 11 ème Congr. Int. Hort. (Rome), 1935, pp. 3.
A fixed character which enables the valuable Zagloul date to be distinguished in a vegetative state from the 10-12 times less valuable Hayany date is given. It is of importance because owing to close resemblance young plants of the latter are often sold for the former by unscrupulous nurserymen. The distinguishing character is found on cross sectioning a leaflet. In Hayany a continuous line of fibrous bundles shows as a series of dots along the upper and the lower surface of the cross section. In Zagloul they are absent from the region which is right under the midrib of the leaflet.

724. Elden, H. van. 634.651-1.521
Genetic and breeding aspects of the papaya (*Carica Papaya*).
Commun. 11 ème Congr. Int. Hort. (Rome), 1935, pp. 2.
The opinion often expressed in literature that differences exist in sex ratio and sex vigour in papaya was found not to be borne out by experiments, but a sex ratio of male to female 1 : 1 was found to be usual. Only 10% of male plants are required to ensure proper fruit set. Selection by vigour of growth proved of no value in segregating the sexes nor could any other differences be detected until the plants started to flower. A typical XY type of inheritance has been shown from the proportion of 1 : 1 male to female plants in populations recorded, which is further substantiated by a study of seedlings from fruits occasionally produced on male plants. These gave a 1 : 2 ratio. Selfed hermaphrodite plants showed a ratio of 1 female to 3 hermaphrodite. As a result of these observations it is recommended that 4 seedlings should be set in each hill when the plantings are 9 feet square, to be subsequently reduced to 1 when the sexes are distinguishable. This will ensure that finally only 12½% of the stand will be males.

725. Anon. 634.771/773
Banana investigations. (By C.S.I.R. Aust.)
J. Coun. sci. industr. Res. Aust., 1935, **8** : 241-2.
Important results have already been achieved from experiments on the ripening of bananas and on transport conditions. The causal organisms responsible for " squirter " and " black-end " have been identified and possible control measures are now under investigation. The condition known as " rubbery " or " leathery " banana is also under investigation. Faults in banana cases have been investigated and results have been published. Finally, information is being collected on banana bye-products.

726. Cheesman, E. E., and Larter, L. N. H. 634.771/3 : 576.3 + 575.1
Genetical and cytological studies of *Musa*. III. Chromosome numbers in the *Musaceae*.
J. Genet., 1935, **30** : 31-52, bibl. 20.
The result of a large number of chromosome counts indicates that the basic haploid number in bananas (*Eumusa*) is 11. Of 29 fertile varieties all but 2 were diploids (2n =22). Of 92 seedless, edible bananas 81 varieties proved to be triploids (2n =33) and 9 sterile diploids. The number 11 also occurs in *Ravenala*, *Strelitzia*, and *Heliconia*, although in *Strelitzia reginae*

2n =14, and in *Heliconia* the majority of species examined showed 2n =24. Further indications are that in *Physocaulis* the basic number may be 9, and that in *Rhodochlamys* it is probably 10. The evidence supports the accepted taxonomic views that a relationship exists between *Ravenala* and *Strelitzia*, and suggests possible affinities between *Strelitzia* and *Musa*, section *Rhodochlamys*, but not between *Musa*, section *Eumusa*, and any other genera of *Musaceae*. In concluding the author states that " on the whole, these observations tend to emphasize heterogeneity rather than affinities, not only in the family *Musaceae* but within the genus of *Musa* itself ". [From authors' summary.] Parts I and II appeared *Ibidem*, 1932, 26 : 291-316, *H.A.*, 1933, 3 : 2 : 254.

727. Walters, E. A. 634.771/3

A guide to the cultivation of bananas for export.

Publ. Dep. Agric. St. Lucia, 1934, pp. 24.

This useful guide to the cultivation of Gros Michel bananas in St. Lucia has been written with the co-operation of Mr. G. M. Glasgow, who recently made a tour of the banana areas of Jamaica. The following are some of the more important points made. Under conditions where irrigation is not practised rainfall should be at least 70″ per annum. Soil should vary from a light loam in valley bottoms to a somewhat clayey loam on hillsides, both with a minimum depth of 18″ good soil, and a subsoil that is not impervious. Soil reaction should not be above pH8 or below pH5, as the lower the reaction the more subject is the area to Panama disease. In preparing the land undergrowth is first removed, contour drains dug, and then large trees are felled so as to lie across the slope and form terraces. The most important consideration in selecting planting material is to obtain suckers free from Panama disease and from borers. Of the various types of sucker the most satisfactory is the " maiden " head, that is a plant which bears ordinary broad leaves, but has not yet fruited. When planting material is scarce, these heads may be sectioned lengthwise into 3 or 4 pieces, which should each retain at least one healthy bud or " eye ", and should weigh not less than 8 lb. The spacing found most suitable in Jamaica, and considered best also for St. Lucia, is single plants 11′ × 11′ = 360 per acre, or two plants per hole at 14′ × 14′ = 444 per acre. Planting holes should be 2′ deep by 2′ wide. In all planting, pruning, and similar operations care should be taken to avoid unnecessary checks to growth. A uniform stand is considered important, and plants which die or develop poorly should be replaced, efforts being made by cultivation and manuring to encourage the replants to overtake the main stand. The main object of cultivation is to keep the land free of weeds. Pruning is an important consideration, and its object is to maintain throughout the year a steady supply of well-formed full count bunches of nine hands. The programme may, however, be varied to regulate cropping according to market demands or climatic conditions. In St. Lucia the heaviest crop and best quality fruit is generally borne during July. If planting is done between February and April, a crop should be produced in July of the following year, that is 14 to 16 months later, and subsequent ratoon crops 12 months later. To achieve the best results, all side suckers should be removed until the main sucker is about 5 months old or 5′-6′ tall. After this one side sucker should be chosen to produce the first ratoon crop, or two may be left, the weaker being cut out later. In the normal course of field sanitation all prunings and other refuse should be chopped up and spread over the field to dry. Where Panama disease, caused by the fungus *Fusarium cubense*, appears however, methods of sanitation must be altered, and isolation and treatment of the site performed immediately. The way in which this should be done is described. In addition to Panama disease mention is made of the Moko, or Macabou disease, and of the weevil and banana borer pests. Instructions are given for harvesting and grading the crop with particular reference to Canadian market requirements. Under existing contracts rates payable at the wharf are 50 cents for bunches 9-hands or over, this being the " count " bunch, 8-hands at three-quarter-count, 7-hands at half-count, and 6-hands, if required at all, at one-quarter-count. A calendar of operations and costs is appended, and in the form of a subsidiary article, derived from a report presented by the representative of the Canadian Banana Company, specific suggestions are made on the reaping and transportation of bananas for export in St. Lucia.

728. Barnes, H. 634.771/773
Banana growing. The one bunch one sucker system.
Q. agric. J., 1935, **44** : 464-8.
The following method is stated to increase greatly the yields of banana groves in Queensland. The system, which is one of desuckering, starts with the selection of stock for planting. "Bits" which consist of portions of the corm bearing well-developed eyes, or if bits are unavailable small healthy suckers of about 3 inches in diameter, form the best planting material. The bits or suckers are planted in a hole 6 inches deep. This is only filled up to 3 inches when planting so as to prevent the corm forming too near the surface. The "follower", which will succeed the sucker after this has fruited, will generally arise on the side of the sucker away from the parent. Thus it is possible to control the direction from which the follower will grow. This will usually be on the top side, but if the slope is very steep, a position at the side is preferable, otherwise the old corm when rotting allows the young plant to sag forward. As soon as suckers appear above ground round the maiden plant they must be removed or the size and quality of the expected bunch will be adversely affected. The follower should be chosen from those forming about 5 inches below the top ring of eyes which will be found at soil level. After the correct choice of the first follower those for succeeding years will probably be found to be correctly placed without attention from the grower, i.e. in a straight line with the original plant and the first follower. Followers should not be allowed to grow on the downward slope. Fourteen months elapse between planting and bunching. Armed with this knowledge it should not be difficult for growers to select the follower so that the fruit is not in process of formation during the cold weather, such fruit being usually unprofitable.

729. Hoette, S. 632.48 : 634.771/3
Certain aspects of investigations on black-end disease of bananas in Australia.
Pamphl. Coun. sci. industr. Res. Aust., **58**, 1935, pp. 22, bibl. 15.
So-called black-end may be caused by invasion by several fungi including *Gloeosporium musarum* Cke and Mass (ascosporous stage *Glomerella cingulata*), *Nigrospora Musae*, *Thielaviopsis paradoxa*, and various *Fusarium* spp. The first, *G. musarum*, is the most important agent and its various forms are described at length. Inoculation tests, which present certain difficulty owing to the presence of the spores of the causal organism in large numbers on the fruit brought in from the plantation, confirm the facts obtained by isolation and observation. Exposure of plates in the ripening room shows that infection does not take place there.

730. Hagan, H. R., and Collins, J. L. 632.651.3 : 634.774
Studies on varietal resistance of pineapple plants. Part II. Plant resistance to *Heterodera marioni* (Cornu) Goodey.
J. Hered., 1935, **26** : 35-46, bibl. 1 in text.
The resistance of four pineapple varieties to the nematode, *Heterodera marioni*, was studied by comparing growth in sterilized compost in root observation boxes with the development of a comparable series of plants grown in compost to which nematode egg masses had been added. The plants were examined when 8 months old. Ranked in order of resistance as based on the number of galls produced the four varieties were Wild Brazil, Lot 520 (Cayenne × Wild Brazil hybrid), Pernambuco, and Cayenne, the latter being the variety commercially grown in the Hawaiian Islands. The average number of roots was not influenced by infestation, but the average length was reduced for Cayenne and Pernambuco. The number of leaves per plant was likewise unaffected, probably because differentiation had occurred before the tests were started, but the average weight of leaves, which represents about 83% of the total plant weight, was materially reduced by infestation in Cayenne, to a less extent in Pernambuco, still less in Lot 520, and practically not at all in Wild Brazil. The same experiment was duplicated for all varieties, except Wild Brazil, using soya tubs instead of root boxes as containers. These contained a larger volume of soil and promoted the formation of a larger number of roots, but the response was distinctly greater for Lot 520 than for Cayenne or Pernambuco. The effects of nematode infestation were, however, comparable with those obtained in root boxes.

The following also are noted :—

CHEESMAN, E. E. **The vegetative propagation of cacao.** *Trop. Agriculture, Trin.*, 1935, **12** : 240-6, bibl. 14.
Reproduced from *Emp. J. exp. Agric.*, 1934, 2 : 40-50, bibl. 14. [*H.A.*, 1934, 4 : 2 : 273.]

TAVALLETTO, G. La coltura del ricino nelle colonie italiane. **(The cultivation of the castor oil plant in Italian colonies.)** *Ital. agric.*, 1935, **72** : 307-18.

STORAGE.

731. TINDALE, G. B., AND TROUT, S. A. 664.85
The preservation and storage of fruit.
J. Aust. Inst. agric. Sci., 1935, **1** : 109-11.

These notes refer to the work being carried out jointly by the Council for Scientific and Industrial Research and the Victoria Department of Agriculture, Australia. With all fruits in storage the rate of respiration increases to a point, termed the climacteric, then falls either rapidly or slowly according to the variety and when it ceases altogether the fruit is dead. The disorders which occur in storage manifest themselves during the downward drift. Pears removed from cool store before the climacteric can be ripened perfectly if placed in temperatures approximating to their normal ripening temperatures. For example Williams, a summer pear, requires a ripening temperature of about 65° F. while Winter Nelis will ripen at 50° F. The date of reaching the climacteric in cool store and the date of picking do not vary appreciably, so that the storage life of any particular variety can be regarded as a fixed character. At 30-32° F. Williams has a storage life of 12 weeks while Winter Nelis will keep for 6 months. Plums behave in a similar manner to pears, but have, when picked green and immediately stored at 32° F., a storage life of only 8 weeks. Peaches last only 5 weeks. Apples and oranges behave differently to pears and plums. If picked green they store well but are flavourless, and if picked when too mature their storage life is reduced. A general rule is to pick apples when the green colour is turning yellow, and to pick oranges when they are of fair eating quality. Both are picked closer to the climacteric than are pears and their qualities do not so rapidly deteriorate with the decline of respiration, the rate of which with them is slow. Senescence in apples and oranges is marked by a rise in the respiration rate following the decline from the climacteric. A complete loss of flavour supervenes in both fruits while the orange loses all resistance to mould attack. The maximum length of storage for Washington Navel appears to be about 12 weeks.

732. CARNE, W. M. 664.85.11 : 632.1
Apple investigations in Tasmania. Miscellaneous notes. 6. Bruising and breakdown in Jonathan apples.*
J. Coun. sci. industr. Res. Aust., 1935, **8** : 223-4.

These are notes on the report made by N. E. Holmes and others on 40 boxes of Victoria Jonathan apples examined on arrival in London in 1934. It was there stated that " in apples showing early stages of breakdown it was obvious that in almost every instance the disease commenced as a bruise ". The present author speaking from personal experience in Western Australia and Tasmania considers that, although bruising is always a potential stimulus to breakdown in the Jonathan, it is in general one of the least important causes in local cool stored fruit.

733. EAVES, C. A. 664.85.11
Preliminary study of the effect of a series of temperature changes upon the respiratory activity of apples during the post-climacteric in senescent decline.
Sci. Agric., 1935, **16** : 28-38.

1. The weighed tube method of estimating CO_2 in a moving air stream was investigated and as a result this technique was used in the experiment reported. The results of the experiment indicate that this method is applicable for respiratory studies upon relatively large samples of apples. 2. The effect of temperature upon the metabolic drift of Bramley's seedling apples during the senescent phase was studied. Respiratory activity of the check lots stored at 3° C.,

* See also *H.A.*, 1935, 5 : 1 : 44, and 5 : 3 : 494.

10° C., and 18° C. was characterized by a rise in CO_2 output to the climacteric followed by a decline. The length of life of the apple and the onset of the climacteric in terms of CO_2 output are in an inverse ratio to the rise in temperature. 3. The onset of fungal invasion causes a rise in the curve of respiration. 4. The effect of a series of temperature changes upon the fruit is influenced by the gradient of change and the time of the change. Sharp initial upward temperature gradients 3° C.-18° C. resulted in a heavy depletion of effective substrate as shown by excessive lowering of respiratory activity. The sharp downward gradient initially reduced subsequent respiratory activity. The gain in relative length of life of the 18° C. variates was found to be higher in proportion to the loss suffered by the 3° C. variates. Results showed that a mean steady temperature of 10° C. tended to be more favourable to the life of the apple than did sharp upward temperature fluctuations from 3° C. although the fruit was stored longest at that temperature. [Author's summary.]

734. Turner, H. 664.85.11
New Zealand fruit. Transport and storage problems.
Food Manuf., 1935, **10** : 403-7.

This article deals with the transport and storage of apples. At the outset it is remarked that the problems involved coincide very closely with those affecting Australia, and that work in connexion with their solution is proceeding on almost parallel lines in the two countries. The number of varieties of New Zealand apples on the approved list for export has been reduced from nearly 100 to less than 30. Among these each variety has its own peculiarities in regard to maturity date, keeping qualities, etc., and there are even variations within the variety induced by differences in locality. As regards storage temperature it has been definitely established that broadly speaking the limits of temperature tolerance for apples in transport lie between 30° and 38° F., Sturmers, Jonathans and Cox's Orange Pippins requiring 36°-38° F., and all other varieties a lower temperature. There are two principal methods of refrigeration in ships' holds. The grid system in which grids, through which refrigerated brine is circulated, are utilized within each hold, and the battery system in which cooled air is blown through the holds, the direction of the air stream being reversible. Research into methods of stacking and dunnage at Ditton Laboratory* has resulted in the discovery of more efficient methods for the equalization of temperature conditions throughout the hold. These methods have already passed commercial shipment tests with complete success. They are : (1) The shaft system for grid holds, in which shafts or towers are distributed throughout the fruit stack to varying depths, meeting at their termination lateral channels formed by battens of 3″ × 3″ timber. This method eliminates the block which used sometimes to occur under the old system of narrow vertical air channels, when the ascending warm air would jam the descent of the cold air from the overhead grids. (2) The no-dunnage system for battery holds, in which all dunnage is eliminated and the fruit cases are stacked in a solid block and the vertical air current reversed 25 to 30 times an hour. By this system the air is forced through the cases themselves and thus the individual apple is more efficiently cooled than when the air passes by the fruit along channels. The main forms of wastage are : (a) bitter pit, which can be combated by later picking and transport at a lower temperature, (b) low temperature breakdown, which occurs in some varieties at 34° F.—thus Cox's Orange Pippin is not only intolerant of low temperatures but also susceptible to bitter pit at high ones, so that a compromise temperature has to be fixed for this variety—, (c) fungal rot due to late picking or to too high a temperature in transport, (d) bruising which is universally a serious cause of loss and presents a problem demanding co-operative action by Empire fruit growers. The article concludes with notes on various research organizations in England and New Zealand engaged on fruit storage problems.

735. Harding, P. L., and Haller, M. H. 664.85.25 : 632.19
Peach storage with special reference to breakdown.
Proc. Amer. Soc. hort. Sci. for 1934, 1935, **32** : 160-3, bibl. 1.

All varieties of peaches tested developed breakdown when stored at 40° F., usually after about two weeks. Further breakdown often developed during ripening at 70° F. Decay, principally

* Kent, England.

brown-rot, was also most prevalent under these conditions. Storage at 32° F. was more satisfactory, but breakdown tended to occur after about 5 weeks even with the most resistant varieties. The following list is given of the maximum storage lives of different varieties at 31-32° F. :—New Jersey 66 and New Jersey 12722, 4 to 5 weeks ; Late Crawford and J. H. Hale 4 weeks ; Slappey, Augbert (Roberta), and Elberta 3 to 4 weeks ; Belle, Champion, Hiley and Carman, 2 to 3 weeks.

736. Chen, S. H. 664.85.3

Storage of citrus fruits (1). [Chinese-English summary.]

Bull. Coll. Agric. For. Univ. Nanking, China, **28** (n.s.), 1934, pp. 27, bibl. 13.

Several types of orange were kept in storage at a temperature of 5-12° C. and a relative humidity of 90% or over. Careful as opposed to rough handling materially reduce the amount of *penicillium* rot. In storage the acid content of the fruit decreased, and loose-skinned oranges which were initially low in acid became insipid in flavour after 4 months. After five months the pulp was dried and shrunken, although externally the peel appeared normal. Thick-skinned oranges with high acid and solid content on the other hand are considered to possess good keeping qualities. Soaking the fruit in 5% borax solution at 32° to 40° C. for 5 minutes immediately after picking reduced *penicillium* rot, but caused some injury to the stem end. [From author's summary.]

737. du Plessis, S. J. 664.85.8 : 632.4

Studies on the wastage of grapes.

Fmg. S. Afr., 1935, **10** : 415-6, 425.

Of the eight different types of wastage encountered in export grapes during the 1934-5 season the following five were the more common :—(1) Grey mould or *botrytis* rot, which was not of much importance at the beginning of the season, but gradually increased until at the end it was causing by far the greatest loss. (2) Blue moulds or *penicillium* rots, and (3) *cladosporium* rot, which together caused most of the wastage early in the season. (4) Black moulds or *aspergillus* rots. (5) Pinhead mould or *rhizopus* rot, both of which occurred only sporadically in stored grapes. A manurial experiment carried out in the Constantia area indicated that nitrogen, especially when applied late in the season, increases susceptibility to wastage, that potash has a slight tendency in the same direction, but that superphosphates increase resistance. Experiments to compare the relative efficiencies of copper-sulphate dust and Verderame sulphur dust showed that the former gave the more effective control of *penicillium* and the latter of *botrytis* storage rots. Further experiments showed that the effectiveness of copper-sulphate dust in controlling *botrytis* was enhanced when rain fell shortly after the application, and that picking should in that case be deferred for at least two clear days after the rain. A fair measure of control may also be obtained by dusting immediately after rain. In packing the grapes satisfactory results were obtained by the use of ordinary grape wrappers treated with iodine or potassium iodide. The only apparent disadvantage of this method was the staining of the wood wool packing an unattractive yellowish brown colour. Formaldehyde fumigation proved effective in controlling *botrytis* and *penicillium*, but was less successful with *rhizopus*. Moreover, certain varieties of grapes are susceptible to formaldehyde damage. A concentration which proved effective and fairly safe was 4% (volumetric), i.e. 5·8 pints 40% formalin solution mixed with 46 oz. potassium permanganate per 1,000 cu. feet, the process continuing for one hour before packing. The application of liquid formalin as a spray to various parts of grape packs showed the best method to be the spraying of the wood wool lining with a 4% solution of formaldehyde until it became " dewy wet ". The bunches could then be packed, either wrapped in ordinary wrappers or unwrapped, since although wrapping reduced the effectiveness of the treatment, the results were still very satisfactory.

738. van der Plank, J. E. 664.85 : 632.11 : 519

Some aspects of the error of estimates of wastage in stored fruit.

J. Pomol., 1935, **13** : 223-31, bibl. 2.

The investigation is concerned with the factors which influence the magnitude of the standard error of estimates of wastage in samples of fruit which are stored for a limited period comparable

with that used in commercial practice to bring the fruit from the grower to the consumer. The problem is complicated by the fact that the distribution of wastage among replicates is discontinuous, as a result of which :—1. The percentage standard error is greatly influenced by the amount of wastage developed in the sample. 2. When only a small amount of wastage has developed, the percentage standard error always tends to be high, and a comparison of the wastage in samples is consequently difficult. 3. As wastage increases, the percentage standard error decreases, at first rapidly but later more slowly until finally it approaches a minimum and further increases in wastage have scarcely any effect. When only a small amount of wastage is anticipated in an experiment, a large gain in experimental efficiency may therefore be expected from measures designed to increase wastage. When, however, a large amount of wastage is anticipated, there is little purpose in attempting further to increase the wastage. 4. The selection of more uniform fruit, its handling under more uniform conditions and other measures designed to make samples less heterogeneous are not effective in reducing the standard error when only a small amount of wastage is present. Such measures should be used only in experiments in which a large amount of wastage is expected. These conclusions have been reached with the aid of the simplifying assumption that the coefficient of variability (i.e. the percentage standard deviation) is a measure of experimental efficiency. This assumption becomes inaccurate when the proportion of wastage is very high (above about 30%). The conclusions are therefore not intended to apply at this stage. [Author's summary.]

739. ANON. 664.85.037

Ya no hay necesidad de refrigeradoras para el transporte de frutas tropicales. **(Refrigerators unnecessary in the transport of tropical fruit.)**

Rev. agric. Guatemala, 1935, **13** : 296, transl. from *Hamburg Anz.*, 15.5.35.

Allusion is made to a new German process named " Skinophan " which preserves fresh fruit, eggs, greenstuff, etc., in the original fresh condition over a considerable period without the need of refrigeration. The material to be preserved is plunged into a liquid which on withdrawal dries quickly and forms a transparent skin. It is tasteless, odourless and harmless. Its effect is to inhibit further maturation of the fruit. A shipment of 8,000 Mexican pineapples treated by this process were sent without refrigeration from the interior of Mexico to Hamburg, a journey of 22 days, and arrived in perfect condition and ready for immediate consumption. The components of this liquid are not stated.

The following also are noted :—

ALLEN, F. W., AND MCKINNON, L. R. **Storage of yellow Newtown apples in chambers supplied with artificial atmospheres.** *Proc. Amer. Soc. hort. Sci. for 1934*, 1935, **32** : 146-52, bibl. 6.

RYALL, A. L. **Certain physiological effects of carbon dioxide treatments of plums.** *Proc. Amer. Soc. hort. Sci. for 1934*, 1935, **32** : 164-9, bibl. 7.

PACKING,‡ PROCESSING, BY-PRODUCTS.

740. GILL, H. C. 664.85

The fruit canning industry of the Empire. An economic survey. IV.

Food, 1935, **5** : 26-8.

Part I* surveyed the fruit canning industry of the U.K. Parts II† and III† are concerned with Australia. Part IV deals with South Africa. The advantage given by the Ottawa agreement to Empire canners over foreign firms amounts with the sugar preference to 17% *ad valorem* on the C.I.F. value in Great Britain. The result of this preference coupled with the fact that Great Britain's departure from the gold standard forced Californian growers to increase their prices caused a general demand for Empire canned fruit. The South African export rose from

* *Ibid.*, 1935, **4** : 268-70, *H.A.*, 1935, **5** : 2 : 311.
† *Ibid.*, 1935, **4** : 326-8, 405-8, *H.A.*, 1935, **5** : 3 : 510.
‡ See also 563.

4,427,778 lb. in 1931-2 to 6,350,846 lb. in 1932-3. The most important canned fruit is the apricot and in this South Africa can compete for quality with any country including Australia. The costs of production and shipments are low, and given co-operation between grower, canner and broker, the trade in this particular commodity should greatly expand. Exports have already risen from 8,408 cwt. in 1930 to 28,835 cwt. in 1934. The fact that there is no organized co-operative advertising for South African fruit such as is undertaken by the Australian growers tends to retard sales. In canning pears much depends on producing exactly the right type of pear at the right stage of maturity. Here co-operation between grower and canner is clearly needed, for in South Africa the technique of pear canning has outstripped that of growing. The only other important South African canned fruit is the pineapple. The fruit here is small, so that processing costs are liable to rise and supplies to the export market to become irregular. Regularity of supply is essential to the commercial success of an export industry. The canned cling peach market is entirely held by Australia and the author considers in view of certain circumstances, which he details, that it would be futile for South Africa to compete. The free stone peach market might be developed to a certain extent, but Canada also competes here. The practical nullification of Imperial preference through the devaluation of the dollar is discussed. This could be cured by replacing the present *ad valorem* duty by a specific duty on foreign produce, a course which would eliminate the danger of financial juggling by foreign competitors endeavouring to defeat this legitimate preference granted to Empire growers.

741. OLDS, G. D. P. 664.85.774

The Malayan pineapple canning industry.

Malay. agric. J., 1935, **23** : 471-6.

The progress is reviewed of the Malayan pineapple industry since 1931 when the Pineapple Conference made certain recommendations, a number of which have been carried out by the Department of Agriculture. Previous to 1931 pineapples had been planted among young rubber trees solely as a catch crop until the rubber matured. As a result of the opening of the Pineapple Experiment Station at Singapore and a policy of land alienation, particularly in the State of Johore, for the purposes of pineapple cultivation, the acreage under pineapple as the sole crop has risen from nil in 1931 to 12,000 acres at the present time. Two pressing problems which are now under investigation both at the Experiment Station and in Johore are those of soil erosion on undulating land, and soil impoverishment owing to continuous cropping. Land for pineapple culture in Johore is now only alienated on special conditions designed to prevent deterioration from these causes. Control over the harvesting and transport of fruit is also necessary to ensure that only fruit in a suitable condition for canning and undamaged in transit should be received at the factory. Hygienic conditions in canning factories have been greatly improved under the Ordinance by which only registered factories complying with regulations laid down by the Public Health authorities are allowed to operate. A scheme of grading somewhat similar to the British National Mark Scheme has been adopted. Participation is voluntary, but factories so registering are subject to surprise inspections. Malayan graded pineapples have already shown a definite enhancement of price as against ungraded. Whether in the grading scheme or not, every tin must bear the official registered mark of the factory. By this means a poor consignment can be traced to its origin and wholesale buyers are also enabled to discriminate in favour of those factories that regularly supply better goods, while competition between factories is also stimulated. There is no doubt that, if the improvement of the past few years continues, Malaya will have a new and valuable industry.

742. ADAM, W. B. 664.85

Varieties and quality of fruits required for canning.

Canning Ind., 1935, **5** : 161-5.

This is a paper read at the Soft Fruit Conference of the Royal Horticultural Society. In strawberries and plums fully developed colour is of great importance. This is a point which should be noted, because it is customary to pick these fruits not fully coloured for the fresh market. All fruit should be firm ripe when it reaches the canners except gooseberries, which should be

green and hard, and blackberries which should be fully ripe. Gooseberries are liable to suffer from capsid bug, the injury taking the form of a small, raised, corky, spot where the skin has been punctured. Principal strawberry defects are malformation of the fruit and a black spot on the end of the berry. Raspberries, loganberries and cultivated blackberries sometimes contain the maggot of the loganberry beetle. This has been largely controlled now by the use of derris. In plums " stone-gum ", a small bead of gum at the tip of the stone, swells when heated and often causes the fruit to split. Victorias are particularly liable to this trouble. Spray residue contamination is rare, but sulphur requires very thorough washing and canners should be advised when sulphur treated fruit is supplied. Undersized fruit is to be avoided, as well as strawberries over $\frac{1}{2}$ oz. in weight or plums over 10 to the lb. The National Mark specifications of minimum sizes should be followed. The most suitable varieties for canning of each class of fruit are discussed.

743. Neal, W. M., and others. 634.3-1.57
The feeding value and nutritive properties of citrus by-products. 1. The digestible nutrients of dried grapefruit and orange cannery refuses, and the feeding value of the grapefruit refuse for growing heifers.
Bull. Fla. agric. Exp. Sta., **275**, 1935, pp. 26, bibl. 14.

Experiments were made to determine whether dried grapefruit cannery refuse and dried orange peel could usefully be included in cattle rations. The process of drying cannery refuse in Florida consists of passing the material through corrugated rollers, which express part of the water and peel oils, and cut it up into narrow strips. The material is then conveyed to a drier heated by a fuel oil furnace. Pressure and suction fans insure circulation of heated air, and constant agitation of the refuse is maintained by rotary paddles. During this heating process the material passes through five compartments, after which it is discharged in the form of coarse flakes and shreds with a moisture content of 10% or less. When dry it takes up atmospheric moisture slowly, and is hard and somewhat brittle, but when soaked like beet pulp it is said to recover its fresh texture. From a stock feeding standpoint it contains a high content of citric acid, pectin, and soluble sugars, whilst glucosides, pigments and essential oils are also present, but crude protein, fibre and fat are low. In the experiments recorded here it was found that, contrary to evidence from other sources, both dried grapefruit refuse and orange peel were palatable to cattle. Total digestible nutrients per 100 lb. dry matter were 82·80 lb. for grapefruit and 80·82 lb. for orange refuse. They are high carbohydrate concentrates, and are laxative if fed in large proportions. In general their effect seems promising, but further studies are necessary before definite recommendations can be made.

NOTES ON BOOKS.

744. Salisbury, E. J. 634 + 635
The living garden.
Bell, London, 1935, pp. 338, illus., 10s. 6d.

This book is written, it is remarked in the preface, with the object of engendering a greater interest in the lives of the garden plants around us, of stimulating a more vivid appreciation of those plants as living entities and of bringing closer the co-operation between the professional botanist and the horticulturist, each of whom perhaps may have opportunities of study and observation denied to the other. And so Professor Salisbury sets out to tell us why things happen in the garden and why plants respond as they do, often in a manner differing with each variety, to heat and cold, light and shade, long days and short days, wind and soil moisture and to the gardener's attempts, sometimes misguided, at assisting them. Now there are innumerable gardening books to tell you *how*, and precious dull some of them are, but those that tell you *why* are few indeed, and fewer still those that can do so in a manner to be understanded of the people. We venture to think that, although the reader's botanical investigations may hitherto have proceeded no further than the uninterested dissection of a cabbage at the

dinner table, he would nevertheless have no difficulty in understanding and appreciating every word in this book. Yet if there are no cryptic technicalities, neither are there long or laboured explanatory substitutes. In that apparently effortless manner which marks the artist, without the slightest hint of talking down, yet with a lucidity of expression that should penetrate the woolliest mind, the hidden mysteries of nature are laid before us, and, we had almost said, "debunked". The author, however, quoting Shelley, prefers much more appropriately to describe his work as an attempt to "lift the veil from the hidden beauties of the world". He has well succeeded. That quotation symbolizes the spirit in which the author has approached his task, the spirit which has enabled him to infuse the vital spark into the dry bones of his scientific facts and to clothe those bones with beauty. The enquiring layman, possibly approaching the book with an apprehension born of past experiences, will need to peruse but few pages before discovering with gratitude that here indeed is that all too "rare bird"—a scientist who can *write*. It might be added that the lady who has provided the illustrations can draw.

745. Kenya Horticultural Society (Ed. Jex-Blake, A. J.). 634 + 635
Gardening in East Africa.
Longmans Green & Co., London, 1935, pp. 330, 12s. 6d.

There are twenty chapters in this book, a foreword and a preface, and with few exceptions each of them is by a different author. Some of these writers are professionally involved in the agricultural sciences and some are garden amateurs, but all, as a glance through the book will show, are completely competent not only to provide reliable instruction, but to do so in a manner entirely readable, and if they occasionally contradict each other—well, *quot homines tot sententiae*, and anyhow the climates and soils of East Africa are sufficiently varied to allow everybody to be right. The book makes an impressive start with a chapter on the climate of Kenya from the gardening point of view by no less an authority than the Director of the British East African Meteorological Service. Here rainfall graphs for twenty-one districts and a number of temperature and humidity tables are presented and supported by concise notes as to how these climatic conditions are to be combated or turned to advantage. Chapters on soils and manures by the Senior Agricultural Chemist of the Kenya Department of Agriculture follow, after which the non-professionals take up the tale with no less erudite chapters on elementary horticulture, propagation, and on each class of garden plants in turn, e.g. annuals, perennials, etc., until chapter 12 in which the Conservator of Forests produces some extremely interesting information on such of the indigenous flora as are worthy of or amenable to horticultural attention. Chapters on lawns, vegetables and fruit follow. Gardening at the Coast as related by the District Commissioner, with its tale of excavations, casualties, successes and defeats and the inevitable order to pack up and move elsewhere arriving with clockwork precision as soon as the author had comfortably dug himself in, makes parts of this chapter read more like the history of a particularly arduous campaign than an account of what is usually considered to be one of the most peaceful of pursuits. After this gardening in Uganda, which occupies the succeeding chapter seems a game for children. Here tropical and temperate plants flourish, cacao and lavender grow side by side, and even if hippopotami do occasionally fight to the death all over the seed beds why complain? Has not every ointment got its fly? Chapters on pests and diseases conclude the book and mention must be made of the Foreword which begins it. This is by Sir Arthur Hill, the Director of the Royal Botanic Gardens, Kew, and thus sponsored the worth of the book may be taken for granted.

746. Imperial Bureau of Soil Science. 016 : 631/5
Bibliography of soil science, fertilizers and general agronomy. 1931-4.
I.B. Soil Science, Harpenden, 1935, pp. 473, £1 5s.

This carefully prepared work should prove of the greatest reference value. Its component parts are:—*Explanatory Preface.* This is necessary and adequate and gives in the simplest terms information on the use of the "Universal" decimal system of classification with special reference to this particular work but actually with a much wider application. These notes

seem to us clear and valuable. Next comes an abridged *Index to Classification Numbers* in which will be found the classification numbers in numerical order. The *Main* and *Geographical Bibliographies* consist of 342 pages of references (about 20 per page) to articles or books on soil science, fertilizers and general agronomy, grouped according to their more important "Universal" number including geographical numbers. This grouping means that all the references to, say, apples—of which incidentally there are 45—will be found together, in one place where they are also automatically sub-grouped by the system into sub-divisions, so that anyone wanting all the references to apple manuring can quickly find them ready grouped for him without having to waste time dodging about from place to place. At the same time where abstracts are known to exist of the articles in question a note of this is made. The fact that no such note is made does not mean that no abstracts are available, and it is felt that in this instance only greater perfection might be attained in future editions. *The Subject Index* gives the "Universal" number of the subjects dealt with and so affords a guide to articles on that particular subject noted in this book. *A List of Abbreviations of Journals and Periodicals* follows, and the work concludes with an *Author index*, which includes 2nd and 3rd as well as the 1st named authors. We are most grateful for this monumental work and feel it merits a place in all agricultural libraries.

747. von Bernegg, S. 633.74 + 633.88
Tropische u. subtropische Weltwirtschaftspflanzen. Kakao u. Kola.
(Tropical and subtropical plants of commerce. Cacao and kola.)
Ferdinald Enke, Stuttgart, pp. 264, bibls. 168 and 26, R.M. 18·70.

This most useful and readable book with its extensive bibliographies contains the following features. *Cacao.* After a brief and witty account of the vicissitudes experienced by the cacao tree and its products up to the present day the author describes its place in systematic botany, its morphology and habit of growth. He considers that all commercial trees can properly be classed as belonging to one of the following varieties :—*Theobroma Cacao* L., *T. leiocarpa* Bern. *T. pentagona* Bern. and *T. sphaerocarpa* Chev. He distinguishes for practical purposes between so-called Criollo and Forastero cacaos and tabulates their distinguishing features in fruits, seeds and plant growth. Under the heading of growth conditions he considers habitat, climate and soil and the demands made by the cacao plant in these respects. He next turns to the economics of production, including land, equipment, labour, methods of planting, shade, wind protection, interculture. He utters a strong plea for vegetative reproduction and for working criollo on to hardier forastero trees. All cultivation practices including pruning are carefully described, particularly detailed information being afforded on green manuring, the advantages and disadvantages of some 62 plants as green manures for tea, coffee and cacao being tabulated. A further table shows the chief pests and diseases, their mode of attack, characteristics and best method of control. Next harvesting, fermentation, and processing in general are described and the chemical composition and possible use of the various parts of the fruits are considered. Cacao production and its importance in the trade of the countries concerned is discussed with regard to the 24 more important cacao producing countries and world trade is shown graphically. In a final tabulatory burst all imaginable questions are answered on necessary growth conditions, physical and chemical composition, and market requirements. *Kola.* The same order is observed by the author in dealing with kola, the absence of research making his task a lighter one. As regards improvement of planting material he notes that the first step would be the observation under definite conditions of the characteristics and growth of some of the innumerable strains of *Cola* spp., selection from these and further observation of vegetative offspring. Actually all that it is possible for the author to do is to state the general cultivation practices, name the common diseases and pests and discuss the average size of crops. This varies immensely, as may be seen from the tabulated details quoted by the author from different authorities. The possible and suggested uses of kola are considered and notes are given on world production and trade.

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